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FOUNDED BY DR. MAX THOREK

Congress Issue

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United States and Canadian Sections
International College of Surgeons
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Vol. XXII *August, 1954* No. 2

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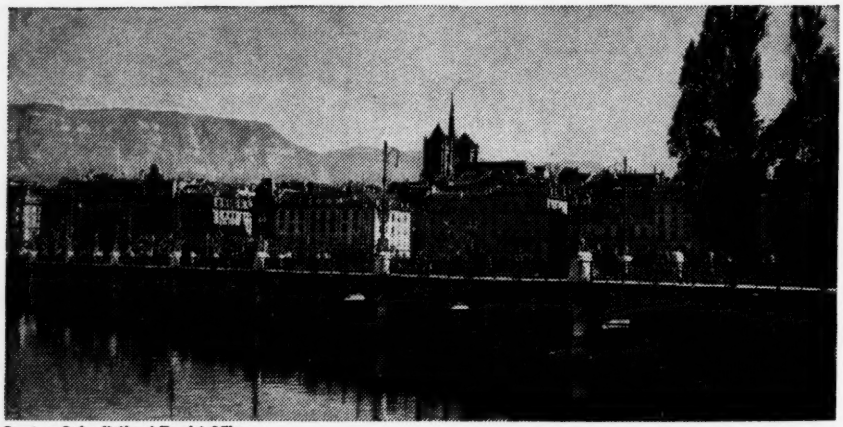

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The Journal of the International College of Surgeons

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Vol. XXII AUGUST, 1954 No. 2

Original Articles

A Cardiopulmonary Machine for Extracorporal Circulation of Blood

ACHILLE MARIO DOGLIOTTI, M.D., F.I.C.S.,**
GIORGIO DEL POLI† AND LEONARDO CALDAROLA§
TURIN, ITALY

A NUMBER of eminent physicians (Haken, Ellis, Nordmann, Bailey and O'Neill) have mentioned the need of improving cardiosurgical technic by devising some form of extracorporal circulation capable of diverting the blood stream away from the field of operation. At our school, which has a Cardiosurgical Center, great interest was shown in an artificial heart-lung and great desire for its acquisition, in order to keep pace with what was being accomplished abroad and planned in Italy.

In the planning and construction of our type of machine (see illustration), the late Prof. Constantini as well as ourselves, Rironti, and Bassé took part. In the beginning it was desired to construct an apparatus suitable for providing a bloodless heart, even if only for a short period. On the advice of one of us, (Prof. Dogliotti), however, consideration was also given to achieving partial extracorporal circulation, which would enable us to avoid the damage associated with total extracorporal circulation and would also provide a well-grounded means of reanimation capable of bringing the functions of heart and lung to the physiologic level at a time of crisis.

The most important aspects of the construction are oxygenation and the decrease of carbon dioxide, processes that may be referred to as arterialization. Our endeavors to reach a satisfactory solution of the problem were unanimous; in fact, the proposed variations and biologic controls were chiefly concerned with artificial

*Summarized form of material previously published (Minerva Med. 1:—, 1944).
**Director.
†Assistant and University teacher.
§Voluntary assistant.
Submitted for publication April 17, 1954.

hematosis. We wished to obviate the damage of oxygenation devices by inverting, so to speak, the usual respective volumes of the two substances in contact, i. e., oxygen and blood. This meant driving the therapeutic oxygen into a blood stream of thick stratum, instead of reducing the blood to a thin stratum in an oxygenated atmosphere.

Our apparatus for oxygenation of the blood and maintaining the physiologic hydrogen ion potential is constructed as follows (see illustration, *2*): A large candle of porous porcelain, similar in structure to the candles used in bacteriologic work, is covered by a glass sheath. Between candle and sheath there is an empty space 3 mm. wide, which serves as a chamber of oxygenation. The system is placed vertically; the blood flows into the empty space from above while the oxygen is introduced from below and disperses in a micro-bubble mist. In this way the formation of froth is almost eliminated.

In several tests, saturation of the blood with oxygen reached 95 to 96 per cent. This is higher than the level considered necessary to provide a margin of safety by most other authors (80 to 90 per cent).

Our apparatus for total or partial extracorporeal circulation, is supplied with two systems for oxygenation which can work singly, together, or in series, according to necessity. In the glass container there are a tube, a tank and a safety glass bubble; the blood, coming from the oxygenating chamber, undergoes a regulated depression sufficient for the partial elimination of carbon dioxide.

The machine is furnished with a group of pumps (see illustration, *3*) driven by electric motors, of pipes which carry out the mechanical functions of aspirating the blood from the venous system, bringing it to pressure, and injecting it into the arterial system. For the propulsion of the blood we have rejected pumps with valves, because they would form fibrin and cause destruction of morphologic elements; and we have adopted, as a suitable mechanical device, the rotating type of pump in which an elastic tube becomes circularly compressed in such a way as to insure a continuous blood stream. To eliminate to the utmost possible extent the contact of the blood with the mechanical device, which causes hemolysis, destruction of elements of the white series and platelets, and formation of fibrin, all our material is coated with silicon varnish, which makes surfaces hydrorepellent (*4*).

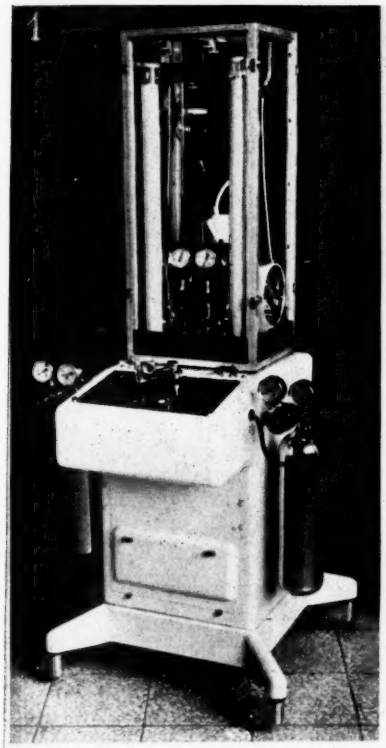
To guarantee the absence of clots, a metallic filter is put at the pipe outlet of the machine; moreover, the cannula of plastic material which is introduced into the patient's venous system is supplied with a heparin dropper (*5*).

The upper part of the apparatus, which contains the means for the flow and collection of the blood, can be easily and quickly sterilized in an autoclave (*6*); in the course of artificial circulation it works like a normal thermostat.

There is also a set of devices to treat the blood in extracorporal circuit either with ultraviolet irradiation or with physiologic or medicinal liquids.

Section 7 of the illustration shows an instance of extracorporal circulation performed with our apparatus. On the right the drawing shows the corporal circulation. In one of the veins connected with the upper vena cava, a tube is introduced for aspirating the blood, which is returned arterialized, in a common carotid. From the sinus of the caval veins the blood is aspirated by the first pump. Brought into the oxygenation chamber, it flows from the top vertically and is enriched by the oxygen given out by the porcelain candle in the form of a micro-bubble mist. Through a large tube, the blood is collected in a

Group of photographs (opposite) illustrating equipment and technic. *1*, cardiopulmonary machine; *2*, apparatus for oxygenation of blood and maintenance of normal hydrogen ion potential; *3*, pumping apparatus; *4*, surfaces treated with silicon varnish to make them hydrorepellent; *5*, heparin dropper; *6*, upper portion of apparatus, which contains the means of flow and collection of blood; *7*, technical schema of extracorporal circulation as obtained with machine described. See text for fuller explanation.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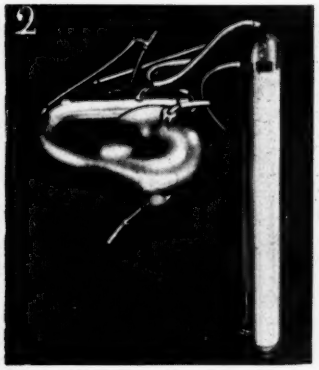
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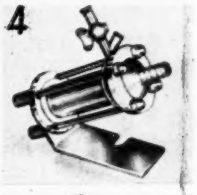
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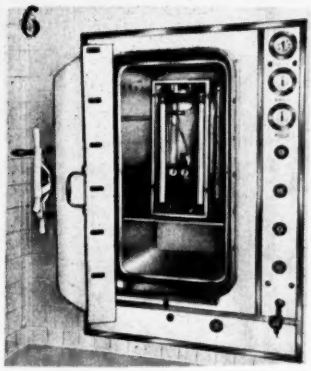
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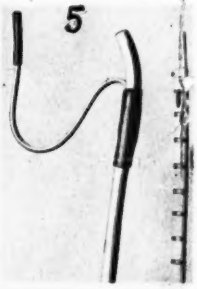
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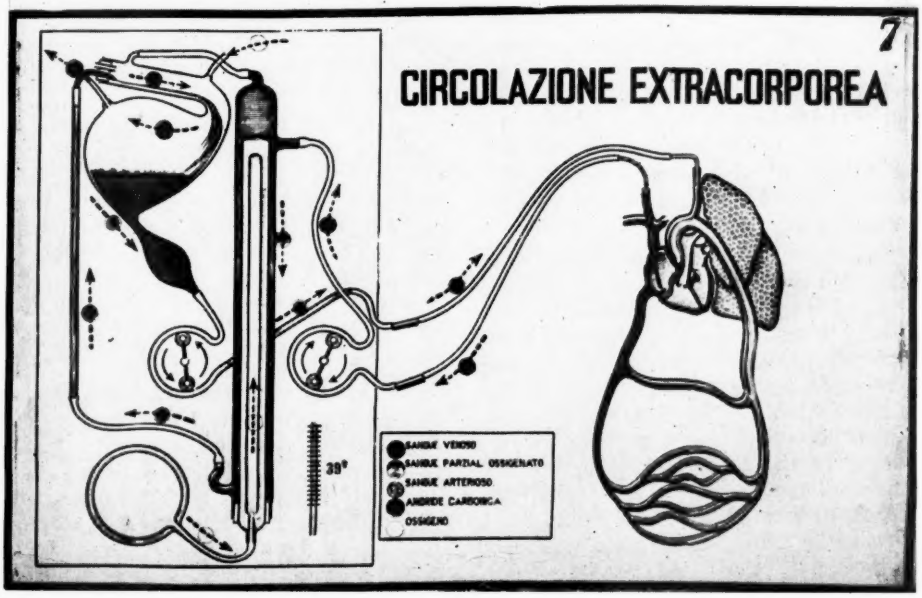
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CIRCOLAZIONE EXTRACORPOREA
39°
SANGUE VENOSO
SANGUE PARZIAL OSSIGENATO
SANGUE ARTEROSO
ANIDRIDE CARBONICA
OSSIGENO

tank in which a depression is made; this has the function of favoring both the elimination of carbon-dioxide and the surface stratification of the froth, which usually forms in negligible quantity.

From the tank, which is equipped with a safety device (glass bubble) by means of a second pump, also of the rotating type, the blood is aspirated, and through another pipe it is carried to the common carotid.

Our researches on extracorporal circulation were undertaken through varied experiments, with trials of the different kinds of operating technics proposed to establish a circuit excluding heart and lung. In a first group of animals, after a right thoracotomy had been done, aspiration of the venous blood was carried out with two cannulas introduced respectively in the upper vena cava through the azygos and in the lower vena cava through the right auricle.

With this experimental device, adopted by Gibbon and afterward by other authors, the whole mass of venous blood (with the exception of that of the coronary circulation, which almost totally reflows in the atrium dextrum) is conveyed to the apparatus.

The quantity of blood that circulates through the coronary system may be rated at about 66 cc. per minute and per 100 Gm. of cardiomuscular tissue. This rather large quantity, which is excluded from the extracorporal circulation, passes into the pulmonary artery and into the lungs, where it can be oxygenated.

Ligation of the pulmonary artery cannot be undertaken, because it causes swelling of the right side of the heart and in a short while causes the organ to stop. Therefore it cannot be stated that, in these experimental phases, "total" extrapulmonary circulation has been achieved. Exclusion of function, however, can be obtained, independently from the way in which blood is drawn, by preventing the animal from breathing by occlusion of the trachea or by covering its muzzle hermetically.

It should be stated that, in these conditions, animals which have not been treated with artificial circulation die, without exception, in periods ranging from three to four minutes.

In a second group of experiments, aspiration of the blood was accomplished in a simpler manner by means of a cannula introduced through the auricle into the atrium dextrum, and the function of the lungs was excluded by ligation of the pulmonary artery.

In a third experimental group, also to avoid the trauma of the thoracotomy and the danger of hemothorax (which sometimes occurs notwithstanding careful hemostasis and the use of protamine sulfate) a plastic cannula marked in centimeters was introduced into the jugular vein, externally at the right (in dogs this vein is much larger than the internal jugular vein) or in the common right iliac vein. The cannula was then made to slide up to reach the atrium dextrum, and the function of the lungs was excluded by obstructing the respiratory tracts.

The return of the arterialized blood to the animal was done in every case by means of a cannula introduced into the cardiac end of a common carotid. Artificial circulation was protracted in different animals for periods varying from fifteen to forty-five minutes.

The quantity of blood made to circulate through the apparatus ranged from 700 to 1,400 cc. per minute, according to the weight of the dog under experiment (10 to 15 Kg.). A partial circulation with a 200 to 300 cc. flow, with the lungs permitted to function, was maintained in several experiments for a long time (up to two hours) without evoking any particular signs of suffering in the animal.

In the animals that underwent thoracotomy the course of the experiment was followed and controlled also with the heart in full sight. It continued to beat vigorously and rhythmically. The electrocardiogram, taken in some cases, showed no pathologic signs worthy of note. In none of the surviving animals, after the experi-

ment and also after a lapse of time, was any deficiency noted which could be attributed to lesions of the central nervous system.

In order to be sure that passing through the apparatus would neither cause alterations of the blood in such measure as to turn it toxic, nor produce serious modifications in its morphologic composition, many tests were carried out *in vitro* and *in vivo*, as well as on biologic controls, all with highly satisfactory results.

Further application of our apparatus has enabled us to gather other interesting data. Performing our experiments with the artificial heart-lung apparatus on dogs, we obtained first-hand results concerning accidents that are often encountered in practice—electrocution, drowning, poisoning from carbonoxide—thus widening the field of surgical reanimation.

On electrocution we carried out experiments by using a single phase (A.C.) of 50 periods and a tension of 200 volts; with a self-transformer we varied the tension from 60 to 220 volts and, by means of a switch with delayed controllable trip gear, charged the animals with electricity for different lengths of time, ranging from one-fifth to five seconds. The two electrodes were placed on shaved skin, respectively on the left foreleg and the right hindleg. The kymograph registrated the femoral arterial pressure and the breathing.

In those cases in which extracorporal circulation was employed, we introduced the cannula for aspiration of the venous blood through the superficial jugular vein up to the atrium dextrum. The two cannulas distributing the arterialized blood were introduced into the common carotid, one cephalad and the other, of greater dimensions, in the direction of the heart.

In a group of animals charged with electricity of reduced potential (100 volts) for a relatively prolonged period (four seconds), we obtained revivification by means of extracorporal circulation, while the control animals, which had undergone the same electrical trauma and had been treated simply with the usual means of reanimation, all died.

In a group of animals given a powerful electric discharge (220 volts) for even a very short time (one-fifth to one second) the use of the heart-lung apparatus proved ineffective. In all these animals, either with the heart in full sight or on electrocardiographic examination, immediate ventricular fibrillation was observed.

In cases of experimental drowning in which the heart-lung apparatus was used, a high percentage of animals returned to life. In those cases in which extracorporal circulation was not employed the animals died, notwithstanding the use of the usual therapeutic procedures.

The electrocardiographic study of the animals that eventually died showed the setting in of ventricular fibrillation, which confirmed the failure of our apparatus in these instances.

The experiments successfully carried out suggest, in our opinion, the following considerations: When the reserve energies of the heart are exhausted, owing to rapid anoxemia, stasis in the right side of the heart or pulmonary insufficiency, employment of the artificial heart-lung, which adjusts these extremely threatening conditions enables one to overcome all danger. Tasks most assuredly fulfilled by the cardiopulmonary machine are those of discharging the right side of the heart, abnormally engaged by the pulmonary barrier and by hypertension from drowning, and of putting into the arterial circulation richly oxygenated blood, so as to prevent prelethal tissue asphyxia of the heart as well as of the cerebral and bulbar centers.

As to acute poisoning from carbon dioxide, in each test two animals were poisoned by illuminating gas, and one of them was used for a control. They were placed in a cowl for chemical researches, hermetically sealed, but were connected with a kymograph registering the pressure at the femoral artery. Both were treated with heparin twenty minutes be-

fore the experiment took place. One of them was connected with the cardiopulmonary machine, the superficial jugular vein and the common carotid having been prepared. During the experiment, the part of our oxygenator set out for guiding the blood flow and for the partial elimination of carbon dioxide, purposely made of quartz, was irradiated with a flood of ultraviolet rays in exploitation of important photochemical effects described by Haldane. In a first series of experiments the poisoning by illuminating gas was not pursued to the point of death. In these cases the extracorporal circulation, strengthened by ultraviolet irradiations, proved effectual.

In a second series of animals the poisoning was carried out until all vital manifestations disappeared. In these cases, notwithstanding the prolonged use of the cardiopulmonary machine (more than half an hour) with maximum oxygenation and ultraviolet irradiation of the blood, we achieved the reanimation of 1 animal only. All the controls died. These results, even if not wholly satisfactory, are not, in our opinion, to be put aside. We are confident that with improved experimental methods, especially in reference to the possibility of releasing a greater quantity of carbon dioxide from the blood by greater depression, better results can be hoped for.

We shall report here, as examples, some cases in which our cardiopulmonary machine had been applied to man.

On Aug. 7, 1951, for the first time, emergency extracorporal circulation was employed. The patient had a large malignant tumor of the mediastinum, which pressed severely on the venae cavae and the right side of the heart.

Removal of the tumor showed it to be particularly hemorrhagic, and, during the phase of isolation the compression on the heart and the mediastinal vessels increased, thus creating immediate danger that the patient would die of arrest of the heart and asphyxia. We then applied our apparatus, which had been prepared beforehand. The cannula for aspiration of venous blood was driven into the upper vena cava, up to the atrium dextrum, passing through the right axillary vein, while the cannula for injecting the oxygenated blood was introduced in the brachial artery.

As soon as the artificial circulation began, there was a rapid and lasting rise of the arterial pressure, with quick resolution of the stasis and disappearance of cyanosis. It was then possible, without further accidents, to remove a great part of the pathologic mass. There followed an uneventful postoperative period, without any evidence of damages attributable to the use of the apparatus, and the patient survived for a year after the operation.

A second case was that of a patient with an esophageal neoplasm and a jejunal fistula, which had formed a month before. Owing to the extent of the esophageal lesion and the probable presence of pulmonary metastasis, together with the general poor condition of the patient (especially from the cardiopulmonary point of view), radical surgical intervention appeared to be impossible. We then decided to establish partial extracorporal circulation to obviate the precarious condition of the right side of the heart and hematosis.

The apparatus had previously been filled with fresh uncoagulable blood recently collected (1,000 cc.) and two cannulas were placed, one at the brachial artery and one at the basilic vein, as in the former case. Heparin solution, regulated by a dropper (2 mg. per hundred cc. of blood) was driven by special appliance into the vein. The increase of coagulation time was finally adjusted by injecting a quantity of protamine sulfate equal in weight to the heparin.

The machine was able to provide a blood flow of more than 500 cc. per minute. The cardiologist who cooperated with us went on registering the cardiocirculatory condition of the patient all through the experiment, suggesting the steps for regulating the aspiration of the venous blood.

The information given us by the spe-

cialist was satisfactory. The extracorporal circulation over, suture of the arterial wound was performed.

On that day and on the following days, diuresis was regular; no trace of pathologic elements, including erythrocytes or hemoglobin, was observed in the urine. Comparison with the electrocardiographic diagrams taken before, during and after the assisted circulation clearly showed an improvement in myocardial vascularization. Even the humeral arterial pressure, especially the differential one, and the pulse beat, were improved after the use of the cardiopulmonary machine.

The first case of mitral stenosis in which operation was performed in an "open field" and with a bloodless heart occurred last year.*

By administering some antihistaminic drug, whose hypnotic properties are known, and a ganglion-blocker (metonium salts), rapid perfrigeration was obtained; then a left anterolateral thoracotomy was performed at the third intercostal space. When the pericardium was opened, mitral stenosis of high degree was discovered by introducing a fingertip through the left auricle; the cardiopulmonary machine was inserted by placing a cannula into the axillary vein up to the upper vena cava and another into the brachial artery.

After a check as to the efficiency of the machine, the pulmonary artery was isolated at its origin and closed with a special clamp. At this point the apparatus for artificial circulation was started, at the rate of 500 cc. blood aspiration per minute, with the purpose of avoiding hypertension of the right side of the heart. At the same time the atrium sinistrum was opened and found practically empty; the anterior commissurotomy was performed with full vision, and after two minutes and fifty seconds, the heart was closed. We avoided, by continual rinsing with physiological solution of sodium chloride, the danger of gas embolism; then, with our apparatus, an endo-arterial transfusion was started with the same blood previously aspirated, which, having undergone abundant oxygenation, had become arterialized. The cardiac operation accomplished, the patient was gradually warmed. The postoperative period was satisfactory.

The results we have obtained with extracorporal circulation, with a trend clearly cardiosurgical, stimulate us to proceed along this line with a certain optimism.

In many pathologic circumstances (acute pulmonary edema, asphyxial syndromes of various types, acute cardiac insufficiency, etc.) it is possible, in our opinion, to obtain favorable results by this means. We are convinced also that it can be usefully adopted during major surgical operations, especially on the heart and brain, and also can be associated with controlled hypothermia. It is a question of new fields, practically unexplored as yet, and it is very difficult to foresee to what extent their achievement will be established. But the aims are so suggestive, and of such an importance, that we hope many other scientists will help us in our efforts to shorten the way and reach more gratifying results.

*Dogliotti-Ciocatto: Bulletin of the Soc. Piemontese di Chirurgia, Vol. XXIII n° 6, 1953.

ZUSAMMENFASSUNG

Der Verfasser beschreibt einen zur Zeit am Universitätsinstitut für Klinische Chirurgie in Turin (Italien) angewandten Herzlungenapparat, der zu Erzeugung der Blutzirkulation ausserhalb des Organismus dient. Erfolgreich ausgeführte Versuche lassen die Anwendbarkeit des Apparates bei Erschöpfung der Kraftreserve des Herzens erkennen, die durch plötzlichen Sauerstoffmangel, Stauung im rechten Herzen, Erstikkungszustände, akutes Lungenödem usw. zustande kommt.

RESUMEN

El autor describe una maquina cardiopulmonar para circulación extracorpórea, actualmente usada en el Instituto Universitario de Clínica Quirúrgica en Turin, Italia. Los experimentos llevados a cabo con éxito sugieren la utilidad de la maquina en condiciones que implican agotamiento

de la reserva energética miocárdica debido a la anoxemia rápida, estasis del corazón derecho, síndromes asfícticos, edema pulmonar agudo, etc.

SUMARIO

O autor descreve uma máquina cardiopulmonar para a circulação extracorporal, atualmente usada na Universidade do Instituto de Cirurgia Clínica em Turim, Itália. Experimentações realizadas com sucesso surgerem a utilidade do aparelho sob condições que incluem exaustão da reserva de energia do coração devido a anoxemia rápida, estase no lado direito do coração, síndromes asfixiais, edema pulmonar agudo, etc.

RIASSUNTO

Viene descritta una macchina cardiopolmonare per la circolazione extracorporea, che è in uso nella Clinica Chirurgica di Torino (Italia). E' stata impiegata con successo in casi di insufficienza cardiaca da anossiemia, da stasi del cuore destro, da sindrome asfittica, da edema polmonare acuto, ecc.

The pursuit of philosophy is founded on the belief that knowledge is good, even if what is known is painful. A man imbued with the philosophic spirit, whether a professional philosopher or not, will wish his beliefs to be as true as he can make them, and will, in equal measure, love to know, and hate to be in error. This principle has a wider scope than may be apparent at first sight. Our beliefs spring from a great variety of causes: what we were told in youth by parents and schoolteachers, what powerful organizations tell us in order to make us act as they wish, what either embodies or allays our fears, what ministers to our self-esteem, and so on. Any one of these causes may happen to lead us to true beliefs, but is more likely to lead us in the opposite direction. Intellectual sobriety, therefore, will lead us to scrutinize our beliefs closely, with a view to discovering which of them there is any reason to believe true. If we are wise, we shall apply solvent criticism especially to the beliefs that we find it most painful to doubt, and to those most likely to involve us in violent conflict with men who hold opposite but equally groundless beliefs. If this attitude could become common, the gain in diminishing the acerbity of disputes would be incalculable.

—*Russell*

Complete Extrathoracic Esophagoplasty

E. VON NOVAK, M.D., F.I.C.S.*

DACCA, PAKISTAN

AS long as twenty years back, my coworkers and I became much interested in establishing a routine, safe method to form an extrathoracic esophagus. The horizon in this particular field was then rather gloomy. There have been brilliant successes all over the world; nevertheless, the scarcity of patients in need of that operation, their low resistance and the overcomplicated methods in current use made it a rather risky operation.

I fully agree with Grey Turner's statement that the mortality rate has been not less than 35 per cent and that not more than 50 per cent of the patients on whom operation has been begun have carried through to a successful conclusion.

Some twenty years ago, in Hungary, the esophagoplasty had great practical importance. Each country and each era has a favorite method used by persons who wish to commit suicide. In Hungary the cheap, strong, alkaline solutions used for household purposes were sold freely; hence, they were widely used for suicide. Strong acid solutions being difficult to get, none of my patients have been poisoned by them. Moreover, in the households of the poorer classes, the strong alkaline solutions frequently lay on the shelf in a ordinary bottle, so that small children had free access to them. It cost us many years of hard work to persuade the Parilament to ban the free selling of these dangerous solutions. Meanwhile all the large hospitals have been forced to establish special departments for the treatment of the unfortunate victims.

With prohibition of the free distribution of strong alkaline solutions the incidence of poisoning dropped sharply. Cases became rare. The question could have been put forward, has esophagoplasty in its complete form any longer any great practical interest? The answer must be a definite "Yes." In the past twenty years thoracic surgery has developed very rapidly, and modern anesthesia made it possible to operate on the esophagus through the thorax. Improved diagnostic methods brought more and more operable malignant tumors of the esophagus to the surgeon.

In the light of latest experiences with malignant tumor of the thoracic portion of the esophagus, it is best treated by removal of the whole of this part. One should not be content with partial removal. Submucous spread many inches above the tumor is always possible, and malignant cells may be already there when nothing can be seen by esophagoscopic or roentgen examination.

Removal of the thoracic portion of the esophagus opens two possibilities for making a connection between the cervical part of the gullet and the stomach. One is to mobilize the stomach and pull it high to make the connection with the oral stump of the esophagus. The second, in my opinion the safer proceeding, is to finish the first act by removal; to close the aboral stump and bring out the cervical portion of the esophagus above the clavicle and proceed with a complete extrathoracic esophagoplasty later.

It is possible to make a connection with some type of rubber or plastic tube between the cervical portion of the esophagus and the gastrostomy opening. Such a solution, however, would not be tolerable for any length of time, since the patient could not be fully social under the circumstances.

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The method to be described here carried a comparatively low mortality even in the years before any antibiotics or chemotherapeutics were available. Now, with all the modern advances in transfusion and intravenous feeding, the mortality rate should be definitely lower.

The first surgeon who approached the problem was H. Bircher (Germany), in 1894. He performed dermato-esophagoplasty in 2 cases, intending to use a skin tube, formed from the skin of the thorax and connected with the stomach, for connection. Both of his patients died shortly after the operation. Wullstein proposed an extrathoracic esophagojejunostomy; he used a high jejunal loop excluded and reimplanted end to side. The cervical portion of the esophagus and the aforementioned loop were to form an end-to-end anastomosis. In that way the whole of the stomach would be excluded from the digestive process. Wullstein never performed the operation on a living subject.

Roux went a step further; he performed an extrathoracic esophagojejunostomy. That is to say, the aboral part of the jejunal loop, used for connection with the cervical part of the esophagus, was not implanted into the jejunum but into the stomach.

It was not long before surgeons realized three basic principles of esophagoplasty; 1. It is not feasible to connect a skin tube with the stomach, because sooner or later the aboral part of the skin tube will be digested by the gastric juice. 2. It is very risky to bring the jejunal loop up to the neck. With all precautions, in many cases the whole or at least a great part of the loop became necrotic 3. Surgeons noticed in patients with esophagostomies that the swallowed fluid shot out from the opening with considerable force. This force in itself is sufficient to press any solid food down the skin tube, so that peristalsis of

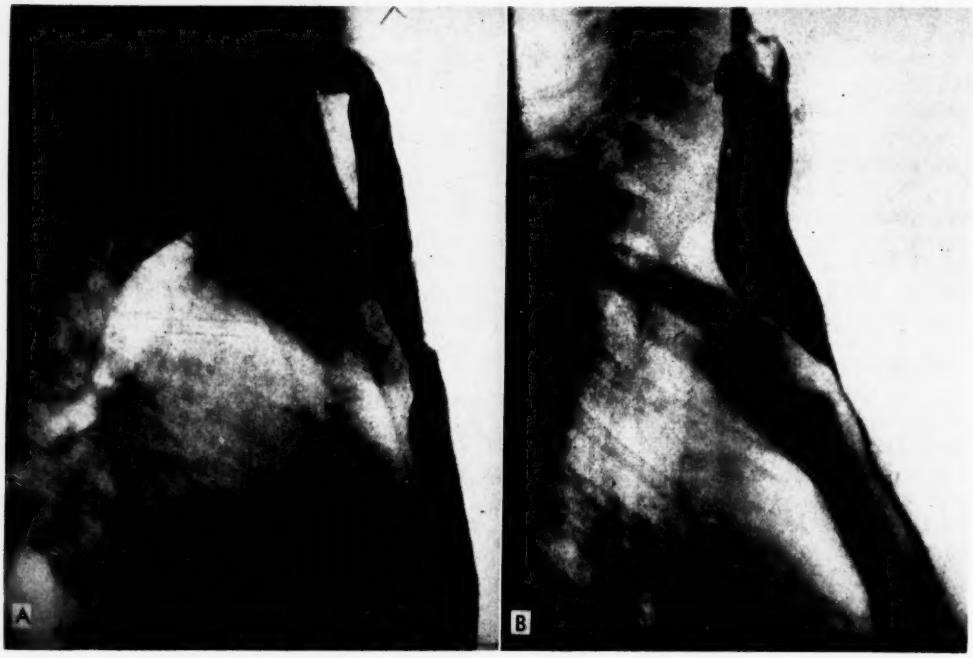

Fig. 1.—*A*, esophagoplasty with side opening of the esophagus into the skin tube. Filling of the blind sack of the esophagus. *B*, esophagoplasty with complete severing of the esophagus. The skin tube is starting to fill.

the jejunal loop is not at all necessary to move the food along the thorax. The end part of the tube will obtain some advantage from the peristalsis of the short connecting loop, but the main purpose of this loop is solely to prevent regurgitation of gastric juice into the skin tube.

By using a short loop only for connections, most of the dangers to life can be avoided.

On these general principles Lexer planned a method of esophagodermato-entero-gastrostomy. My work consisted of building up a routine, safe technic on the basis of Lexer's ingenious idea.

Before going into details in prescribing my own method, I wish to complete the enumeration of different technics of esophagoplasty by mentioning four methods which are basically different from those already described.

The connecting jejunum has been replaced by Kelling and Vulliet with the transverse colon (in an isoperistaltic or antiperistaltic manner). Roitz used the ascending portion of the colon in an isoperistaltic manner. I know of 3 cases from Hungary, in which all the patients recovered uneventfully and did very well.

Later I shall discuss the requirements as to the side of the jejunum to be used as connecting intestine. If these requirements are not present, but the colon is provided with a long and mobile mesocolon, the solution is convenient. Use of the colon seems not to augment the danger, despite the fact that all the patients within my knowledge were operated on long before the use of antibiotics and chemotherapeutics.

Generally it is possible to pull the colon higher than the jejunum, which seems to be an advantage. Although the length of the skin tube is of no importance, the length of the colon is rather a handicap, because the mobilized colon tends to dilatation and possesses only feeble peristalsis. In consequence, the food remains up to an hour and a half in the colon; a sort of first stomach is thus formed, and the patient is forced to massage the food into the actual stomach, if he wishes it to go down more quickly. In none of my 25 cases of jejunal connection have I observed any delay in the passage of food.

Using the method for gastrostomy of Depage and Jianu, Halpern and Hirsch worked out their esophagoplasty, in which they used a stomach tube formed from a section of the anterior wall of the stomach or from the greater curvature. The base of the flap in either instance is near the cardia.

Judging from the results obtained, the method has given fully satisfactory results. The gastric tube preserves some peristalsis, and the connection with the skin tube is not endangered. It may be that the gastric tube does not secrete juice in greater quantity, so that the juice, so dangerous to the skin tube, pours freely into the stomach and in consequence cannot be poured into the tube.

The stomach may be shrunken; in such a case the method is not applicable.

The greatest drawback is the danger that the blood supply to the tube will not be sufficient and that necrosis of the tube, even with fatal peritonitis, may ensue. Surely this is the reason that Jianu's method never gained popularity.

The most ingenious modification is Kirscher's. He uses the stomach itself for short-cutting the stenosed esophagus. The operation runs as follows: The stomach is mobilized from the cardiac end by ligating and cutting all the gastric vessels. Approaching the pylorus, the surgeon must be careful to conserve the vessels near the lesser and greater curvatures. The splenic vessels must not be injured. After mobilization is complete, the stomach is separated from the esophagus in such a way that a small part of the gastric wall is left with the esophagus. The stomach is closed. The esophageal end is connected with a jejunal loop brought high through the mesocolon. The continuity of the jejunum is restored by anastomosis. (Of course, if the operation is done in connection with a preceding esophagectomy, no such connection is needed.) The ensi-

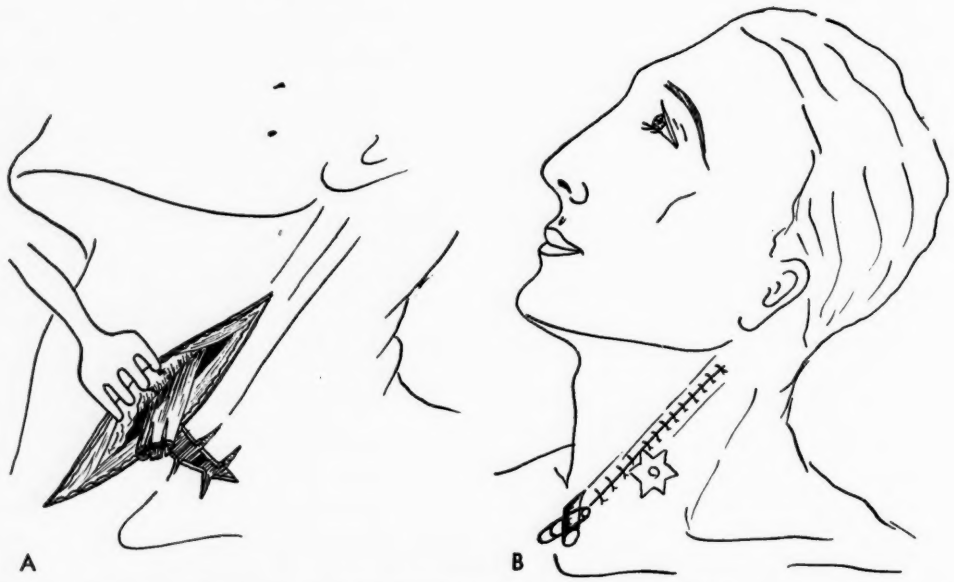

Fig. 2.—*A*, dissected esophagus with small incisions on its end, ready for suturing to the skin. *B*, esophagostomy performed; mediastinum drained.

form process is resected, the skin tunneled and the stomach pulled high. Usually it reaches the left supraclavicular region. The stomach loses its normal shape and is like a tube, the uppermost portion being the fundus. Meanwhile a separate team is dealing with the cervical and high thoracic portions of the esophagus in the usual manner, which I shall describe later, and the aboral end of the esophagus is brought down through the tunneled skin and put in connection with the fundus, if possible, in the manner of a gastric fistula.

The operation has distinct advantages. It can be completed in one stage. For connection the most physiologic organ, the stomach itself, is used. On the negative side there is the formidability of the operation. The whole gastric portion must be completed, lest the stomach shrink. Such an operation is not well tolerated by the debilitated patients who require it.

Apparently the complete vagotomy has no bad effect; the consequent atony is counterbalanced by the even pressure of the fibrosed tunnel.

The presence of a gastrostomy is not a contraindication. The gastrostomy can be readily closed before the operation.

According to my animal experiments, leading the stomach through the mediastinum is not to be recommended. The operation proved much larger and more dangerous, and if the animal survived the stomach showed a ballooning on inspiration.

Under what conditions is extrathoracic esophagoplasty indicated?

1. If the thoracic portion of the esophagus has been successfully removed because of a malignant tumor, and it is hoped that recurrence will not soon take place.

2. If there is extended, impermeable stricture, such as occurs most often after poisoning by corrosives; but foreign bodies housed too long in the esophagus, peptic ulcerations, chronic inflammations theoretically can be the cause, but they

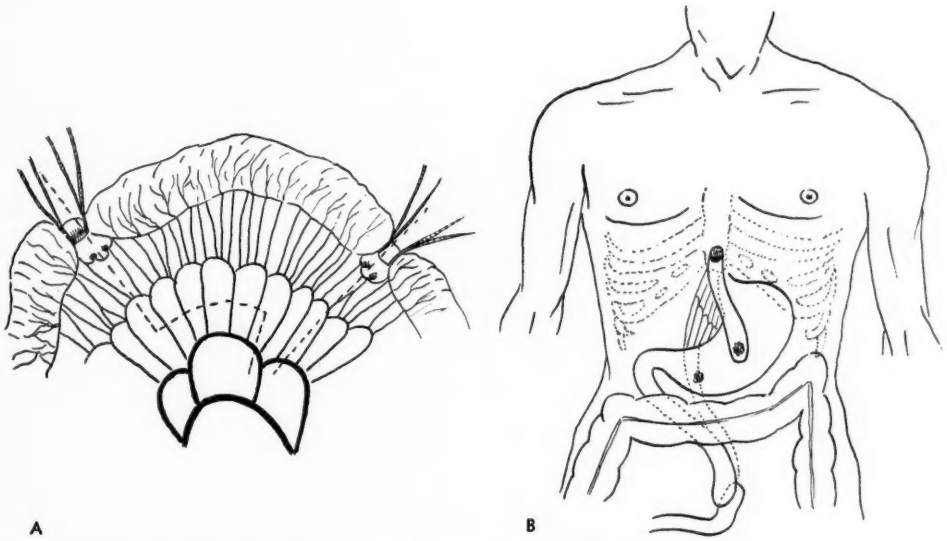

Fig. 3.—*A*, formation of the isolated loop for connection. *B*, retrocolic and retrogastric aspect of the mesentery of the isolated loop.

are not likely to lead to impermeable stricture, and if, the stricture is mostly limited in extension.

3. If there are incomplete extended strictures caused by corrosives, which cannot be brought under control by prolonged treatment.

In my opinion, if the dilatation is giving only a partial result and even this partial result cannot be maintained by periodic treatment, the stricture is likely to deteriorate to such an extent that only fluids can pass. Repeated dilation of such a stricture is not without danger. Whichever method is used, mediastinitis can be the consequence, owing to complete or incomplete rupture or inflammation.

Division by diathermy is far too dangerous to be advised.

In a case of more and more frequent recurrences, an error in the diet or a severe cold can obstruct the tiny patent part, and the patient must be fed through his gastrostomy. Such a patient will be more or less unable to continue his work or live a social life. More important, however, is the fact that, even with gastrostomy, the patient in most cases will die of some intercurrent disease in five or six years. In children, in inverse proportion to age, gastrostomy is even worse tolerated. A child under 10 could not tolerate a gastrostomy for more than two or three years. Whatever method he uses for feeding, the proper physiologic impulse to gastric secretion is diminished. Moreover, the patient is losing precious gastric juice. Gastrostomies, after some months or years, are no longer watertight. They are performed chiefly as emergency procedures and not always by the most experienced hands. Even if they are performed by experienced surgeons at the usual site, midway between the navel and the ensiform process, they will usually leak around the tube. At first it is possible to tighten them by pulling out the tube and replacing it only after half a day or so. Later this method would be useless. The diameter of the tube must be increased. Even this will not serve indefinitely. I have seen a patient with an

enormous tube, which was made even more bulky with cloth, whose whole abdomen was virtually covered with painful dermatitis. I wish to stress the point that a leaking gastrostomy cannot be tightened by surgical means. If it is leaking it must be closed and a new one formed.

It is clear that delay in performing an esophagoplasty on such a patient will cause the situation to deteriorate. Both his organic and his nervous system will be exhausted, and the chances of his tolerating the operation will have diminished.

In cases in which I have the chance to perform the gastrostomy, I perform it below the left costal arch and in the middle. This site is well protected from intra-abdominal pressure. It is my experience that such a gastrostomy does not dilate, and when the plasty is finished it will usually close spontaneously if one scrapes out the epithelium and strips it with elastoplast. If it fails to close completely, operative closure is simple; the fistula will be very narrow, and one will not even need to open the peritoneal cavity. In spite of the somewhat macerated skin, primary union is the rule; these patients are building up, with time, considerable local and even general resistance against the bacilli concerned.

If I am in a position to choose the site of gastrostomy in the stomach I perform it high, as high as possible. If that is not feasible, I place it quite near the pylorus. If I decide to perform esophagoplasty the gastrostomy is temporary, and, in my experience, a gastrostomy near the pylorus does not disturb proper digestion. Gastrostomy in the middle of the stomach is very troublesome, because the site is needed later for connection with the jejunal loop.

My youngest patient was 5 years of age. He supported the esophagoplasty quite well. Controls showed that the newly formed esophagus grew with the child. My eldest patient, a 44-year-old woman with inactive, fibrotic tuberculosis and chronic myocarditis, supported the operation well and has suffered no relapse of pulmonary tuberculosis. Nevertheless, patients with active pulmonary tuberculosis must be excluded until the tuberculosis is controlled. For patients with inactive pulmonary tuberculosis, esophagoplasty offers security against relapse. Proper food intake can be secured only if the passage is restored. Taking into account the modern development of preoperative and postoperative treatment and free administration of blood during the operation, I should not put an age limit to esophagoplasty. The indication depends entirely on the condition of the individual patient. Of course, very old, marantic patients must be excluded. For them the only indication would be malignant tumor of the esophagus, and for such patients esophagectomy would be neither indicated nor feasible.

Syphilis or diabetes is not contraindicative *per se*. The indication depends on whether irreparable organic damages have been caused by the disease and whether the disease can be controlled before the operation. A positive Wassermann reaction after proper treatment is not a contraindication. I operated on a patient from whom we could not elicit a negative reaction in spite of repeated treatment. He supported the esophagoplasty without trouble.

All-important is the condition of the patient. One can start with the esophagoplasty only when this is adequate. The blood pressure must be around normal; anemia must be corrected. One cannot achieve this by artificial means alone. The most important point is to feed the patient properly. Patients after poisoning with corrosives generally have bad teeth, owing partly to the direct action of the corrosive and partly to lack of proper mastication. Most of them do not masticate well. They often turn the food in the mouth once or twice and use the syringe to press it into the stomach. To use the syringe instead of the funnel would not make any difference, but the inadequate mastication is bad for the teeth and even worse for the digestion. Such patients must eat frequently and not too much at

a time and the food should be palatable and nourishing.

Prior to operation the teeth must be looked after.

Two patients had stricture of the esophagus and pyloric stenosis caused by the action of corrosive. In our opinion it is not right to short-cut the stomach and perform an esophagodermatoenteroanastomosis, as was done in some cases. We started with a gastrojejunostomy as the most simple solution. Stomal ulceration is not to be feared because of corrosive action; the acidity is low or anacidity is present. In some cases, perhaps, a gastroduodenostomy would be feasible.

In the following paragraphs I intend to describe our technic, which was developed in the First University Clinic for Surgery in Budapest (Director, Prof. Verebély) and later in the University Clinic for Surgical Technique in Kolozsvár (Director, Prof. von Novak) in 25 consecutive esophagoplasties. Eighteen patients have been operated on by myself and 7 by Prof. Borsos.

We started, as I have mentioned, with the operation of Lexer. Gaining more and more experience, we modified it. At last it seemed that our modified technic gave us reliable, good results, and we used it in our 20 later cases with no further alteration.

Our method is an esophagodermatojejunogastrostomy, in which the jejunum is used chiefly as a connection, the skin tube protecting part. It is an advantage if the jejunum can be brought high, and it is a handicap if one must be content with a short one. In the latter case, in forming and chiefly in covering the skin tube one faces unfavorable conditions while working in the more or less macerated and fibrosed skin around the gastrostomy opening.

In 2 of our cases the stricture extended practically up to the pharynx. In both we succeeded, with inverted skin flaps, in forming a permanent, non-narrowing connection between the pharynx and the surface of the neck.

The first question is whether the whole esophagoplasty shall be completed in one stage or divided into several.

It is definitely possible to complete the whole esophagoplasty in one stage. It was possible even before the great help of modern preoperative methods, and blood transfusion during operation were available. Nevertheless we gave it up, because we noticed that the formidable operation was very badly tolerated even by young and sturdy patients. At present our method is so planned that it can be easily divided into stages, which is of the greatest benefit not only for the safety of the patient but for smoother healing and a better final result. It must be pointed out that, if stricture occurs in any part of the completed esophagoplasty, dilation is practically impossible and only an operative correction can help.

If a gastrostomy has already been done, the first stage is forming an esophagostomy.

Although it is understood that modern anesthetics—cyclopropane, oxygen or light gas- oxygen — would not harm our patients, we consider local anesthesia even better, because it is less toxic; moreover, it does not require a skilled anesthetist and elaborate apparatus. It may be merely that we are accustomed to work with local anesthesia, which enables us to neglect the time factor. All of the stages are time-consuming, and a very delicate technic is required, with the best possible hemostasis. We appreciate greatly the advantages of local anesthesia, in that we are not bound to time at all. The local anesthetic technic we use will be described together with the successive stages of the operation.

We choose as the first stage the forming of an esophagostomy because this stage is not particularly dangerous; we can test the strength of the patient; it gives confidence to the patient for the long-lasting chain of operations, and the after-treatment and eventual correction after this stage sometimes takes a considerable amount of time.

Before proceeding to this stage, in addition to routine examination and preoperative treatment, thorough examination must be made to locate the highest point of the stricture. That can be done by roentgenogram or esophagoscopic study or the two combined. In the immense majority of cases the highest point is around the bifurcation, rather above it. This place corresponds with the level of the third and fourth thoracic vertebrae.

From the day of admission of the patient the skin of the frontal part of the thorax is massaged to stretch the skin, so far as is possible, for formation of the skin tube. With women, because of the breasts, difficulty is rare. In children and men the stretching is very important because of the scarcity of skin.

For anesthesia we use cervical block on the left side, in a modification of Kulenkamff's method. This kind has proved harmless in many thousands of goiter operations. Parvertebral anesthesia of the neck is outdated because of the frequent accidents associated therewith.

The Kulenkampff method can be described as follows: In the middle of the posterior border of the sternomastoid muscle we place a wheal and inject 30 cc. of 0.5 per cent procaine hydrochloride just underneath the superficial fascia. The second wheal is placed ¼ inch (0.6 cm.) to the side and below the major cornu of the thyroid bone. Then 10 cc. of the 0.5 per cent procaine solution is injected around the superior thyroid artery, i. e., roughly 1 inch (2.5 cm.) underneath the cutaneous surface. Both of the injections can be done with a short, fine needle about 1 inch (2.5 cm.) long; accordingly, any deep or dangerous injection is safely omitted.

The incision is placed on the anterior border of the sternomastoid. In most cases the scar will be somewhat broad, cutting through the elastic fibers of the skin. We tried the cosmetic transverse incision but it was somewhat hindering to easy performance of the operation.

It is not possible to know beforehand whether the particular patient is likely to form abundant fibrous tissue. Consequently it is a good policy to resect corresponding parts of the sternohyoid, the sternothyroid and the sternal portion of the sternomastoid. The omohyoid and the facial vein are simply cut through between ligatures.

Fig. 4.—Esophagostomy and enterostomy ready for final stage.

With the great vessels retracted and the muscles to the side, the left lobe of the thyroid confronts the surgeon. The inferior thyroid artery is ligated far from the lobe and severed. If the lobe cannot be sufficiently retracted to the right, one might sever the superior thyroid. In older patients the simplest thing is to excise the left lobe and leave only the posterior part of the capsule and a thin portion of the adherent parenchyma. Behind the left lobe in the loose connective tissue is the esophagus. It is easy to recognize from its light pinkish color, strong muscular wall, and movement on swallowing. If there is any difficulty in recognizing the esophagus, a gastric tube can be introduced through the mouth.

Next, with the greatest delicacy, the esophagus is freed from the surrounding tissues. The recurrent nerve must not be injured during this act. The nerve runs on the wall of the trachea to a certain distance from the esophagus; therefore it cannot be injured if one approaches the esophagus during this phase of the operation.

For preparation, a small hard swab does the best service. The esophagus can be freed without bleeding. The best place to start is the midportion of the esophagus in the cervix. The organ is then freed in its whole circumference. A gauze sling facilitates the work considerably. Step by step the esophagus is followed into the mediastinum about 3 or 4 cm. Supposing that the complete stenosis is, as it was in most of our cases, at the height of the bifurcation, the esophagus above the stenotic area will be enlarged and surrounded by fibrous tissue. The utmost care is necessary not to damage the large vessels in the neighborhood. I do not speak of penetrating injuries; they are easy to avoid; I refer to nonpenetrating injuries of the veins, which later might lead to fatal bleeding if some mild infection develops.

The esophagus is liberated upward as far as it is easy. Five cm. of the esophagus, completely skeletonized, remains living.

Only in our first cases did we use the mobilized esophagus for end-to-side anastomosis with the skin tube (Fig. 1*A*). We soon realized that food first fills the blind sac of the esophagus, and passes into the skin tube only after that. Consequently, the greater part of the pharyngeal muscle action is lost. To avoid this inconvenience we transfix the esophagus doubly, just above the stricture, with strong chromic catgut, cut it through and bring the oral part to the skin surface of the neck. The aboral part is left in the mediastinum, and the wound is drained with a soft rubber tube, which is brought out separately from the main incision, on the deepest part of the neck, just in the midline (Fig. 1*B*).

We never have had any trouble with this method. This part of the mediastinum is fibrotic, and there is no danger of mediastinitis. The mucosa of the esophagus just above the stricture has been destroyed, or at least so damaged that no secretion is present, and therefore blind sac formation never occurred in our cases.

We fix the oral stump to a special incision, which is placed vertical to the main incision. By applying cuts 3 to 4 mm. long in the margin of this incision, and correspondingly cut the esophagus margin in the same manner, we will be able to suture the esophagus to the skin in the shape of a cogwheel. We have noticed that, if this is done, stenosis of the esophagostomy is less likely to occur (Fig. 2).

If the esophagus is not unduly skeletized and not unduly stretched, necrosis will hardly occur. Small marginal necrosis may occur, but correction is easy and there is plenty of time for it during the next stage.

In ten to fourteen days wound healing is so far advanced that one may start systematic swallowing exercises. The patient generally learns easily to use the esophagus in its new position and day by day the growing strength of the pharyngeal muscle action can be controlled.

In some weeks the esophagus will pull the surrounding skin inward and upward, facilitating the future connection with the skin tube.

In rare cases we might think it advantageous to dilate the oral stump. It is easy to do so from either the mouth or the esophagostomy. One thing must be emphasized: once the plasty is finished, there is no possibility of dilating with bougies. Strictured areas must be dealt with surgically.

We recommend high doses of atropine just before operation, but in postoperative treatment we do not use it, since it interferes with the cleansing effect of normal saliva.

Before the introduction of penicillin we used N.A.B. and bismuth to diminish the danger of infection from the mouth. For

cleaning the mouth also we used N.A.B. solution. We cannot say whether penicillin fully replaces our N.A.B. treatment, which gave us very good service.

Before the second stage is undertaken, the patient must be given sufficient time to regain strength for supporting the most strenuous stage, the abdominal. Usually it takes two to three weeks to make the patient fit for this stage. It does not matter if the esophagostomy is not completely healed; there will be plenty of time to wait for that after the second stage.

The tissues surrounding the gastrostomy are more or less inflamed. We do our best to improve the skin condition. It must be mentioned, nevertheless, that such a prolonged inflammation induces a fair amount of local or even general immunity to the common pyogenic bacilli. The abdominal wound heals, as a rule, by primary intention.

Before this stage, if the gastrostomy has been performed elsewhere, one should determine roentgenographically on which part of the stomach the gastrostomy was performed. The incision will be planned on that side, since it offers a greater part of the stomach for implantation of the jejunal loop.

Prior to the operation the gastrostomy tube is removed for some hours to let the opening shrink, but it is replaced just before the operation as a guide to prevent damage of the wall of the fistula.

This stage too is carried out with local anesthesia—infiltration around the planned paramedian incision, and splanchnic anesthesia for the abdominal part, with 50 to 60 cc. of 0.5 per cent procaine hydrochloride. If there are many adhesions it may be necessary, after opening the abdomen, to administer a light general anesthesia for a short time. The most convenient is a small amount of Evipan.

The aim of this stage is to isolate a jejunal loop 18 to 20 cm. long, which has a sufficently long mesentery, and this could be pedunculated securely. Such a loop is likely to be found 30 to 40 cm. from the duodenojejunal juncture.

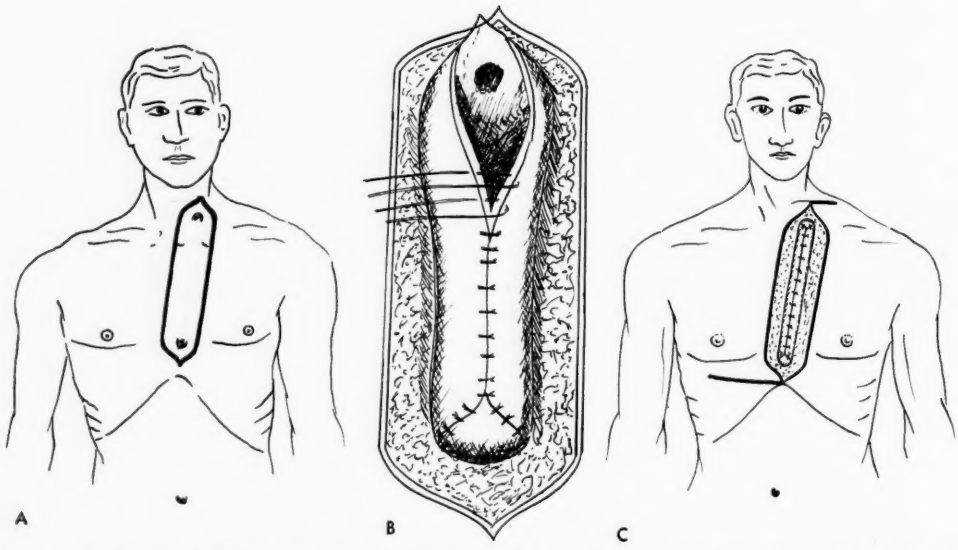

Fig. 5.—*A*, incision for skin tube with connections. *B*, accomplishment of the connections; closing of the skin tube. *C*, accessory incisions for covering the skin tube.

We must now survey briefly the arrangement of the blood vessels of the mesentery. The superior mesenteric artery branches into 15 or 16 intestinal arteries. These form an arch some centimeters from the roof of the mesentery. From the arch the vasa recta are derived, forming again an arch some centimeters from the bowel. This arch supplies the intestine with innumerable fine vessels.

One should choose a place where the mesentery is sufficiently long and one intestinal artery supplies a fair portion of the intestine; that is, the arch belonging to one intestinal artery corresponds to a broad portion of the arch supplied by the vasa recta.

The loop must be skeletized orally beneath the secondary arches, remaining in connection with the mesenteric arch by the intestinal artery. Aborally no skeletization is needed. Turning the mesentery against the light one compresses digitally one straight vessel after the other, watching the finest arteries of the loop to see whether they are pulsating normally. The pulsation must be not even slightly diminished. It must be taken into consideration that when the loop is brought high the vessels will invariably be slightly compressed. It is safer to be satisfied with a shorter loop than to jeopardize the adequate nutrition of a longer one. Repeating the procedure aforementioned, one might start by severing the mesentery. Aborally, without sacrificing a single straight vessel, there will be sufficient space to close the loop (Fig. 3*A*).

On the end the loop will be connected with a stem 1.5 to 2 cm. wide. One might try to suture the two peritoneal layers, but if the closure is pressing on the vessels, this must be avoided. Next the loop itself should be separated and the ends closed, with the sutures left long on the oral portion.

The continuity of the intestine is restored by side-to-side anastomosis. The isolated loop is gently pushed through the mesocolon and minor omentum above the stomach. The sutures left long in the oral portion will guide the loop.

The retrocolic and retrogastric way seems best. The colon and stomach cannot be pressed by the mesentery of the loop, whereas the vessels in the mesentery cannot be pressed by a somewhat dilated colon or stomach (Fig. 3*B*).

For transposition of the loop, one must open the gastrocolic ligament.

During the whole procedure the pulsation of the finest vessels on the oral end, as well as the color of the intestine must be watched. Pallor, deep cyanosis and patchy cyanosis are forecasts of danger. The loop must be pulled back below the colon, and pulled high only when the normal color and pulsation have been reestablished by packing it in hot compresses.

Supposing the isolated loop in the new position shows no sign of impaired circulation, connection must be made between the aboral portion of the loop and the stomach. The aboral end must fit exactly to the selected place on the anterior stomach wall. If it happens to be too long, one must invaginate the unnecessary portion or resect it. The anastomosis is side-to-side, lying in the vertical axis of the stomach. One inch long anastomosis is sufficient.

We do not use clamps, either here or elsewhere, except in cases of intestinal obstruction. We do not wish to damage the wall even in the slightest degree, and we do place emphasis on perfect hemostasis.

All the openings in the mesocolon and the gastrocolic ligament are now closed, the ensiform process is resected and the skin above the sternum tunneled. The oral end will be carefully pulled high by means of the long sutures on the oral end, and fixed to the skin if the circulation is still perfect. If signs of any impairment are present, except a slight bluish tinge, the loop must be pulled back to correct the malposition, that is, to eliminate the pressure. On no account can the abdomen be closed if the loop's circulation is not perfect.

The parietal peritoneum will be sewn as deep on the loop as possible to avoid peritoneal infection if gangrene of the loop should develop.

After this stage the stomach, as a rule, will be paralyzed three to five days. Through the gastrostomy tube the contents can be conveniently drained out. After that period we start to inject small amount of fluids into the stomach, meanwhile draining it out from time to time if necessary.

The greatest danger threatening the patient is partial or total gangrene of the loop. If one waits for the well-known signs of peritonitis, the patient will be lost.

If under the usual careful postoperative treatment (transfusion, plasma, infusion) the pulse rate is unduly increased and the volume and tension are deteriorating, the skin covering the oral end of the loop should be incised. If its circulation is normal, it may be secured again and the patient treated accordingly.

If there is a partial necrosis, the damaged portion should be resected. If the circulation is impaired, control of the loop and its mesentery should be maintained, even if one must cut out the connection with the stomach to change the position of the loop.

If there is thrombosis in the mesentery and the whole loop shows signs of incipient gangrene, the whole loop must be resected and the procedure repeated when the patient is again in fit condition.

In 1 of our cases the stomach was shrunken, and in the available anterior wall was the immensely dilated gastrostomy opening. We cut that out, closed the stomach, connected it from a new incision with the loop, and drained out the stomach through the oral end of the loop. The patient recovered. In this case, before the closing stage is performed, the stomach dilated sufficiently to allow us to form a new gastrostomy.

After ten to fourteen days the cutaneous covering of the oral end is incised, and the loop is opened and sutured securely to

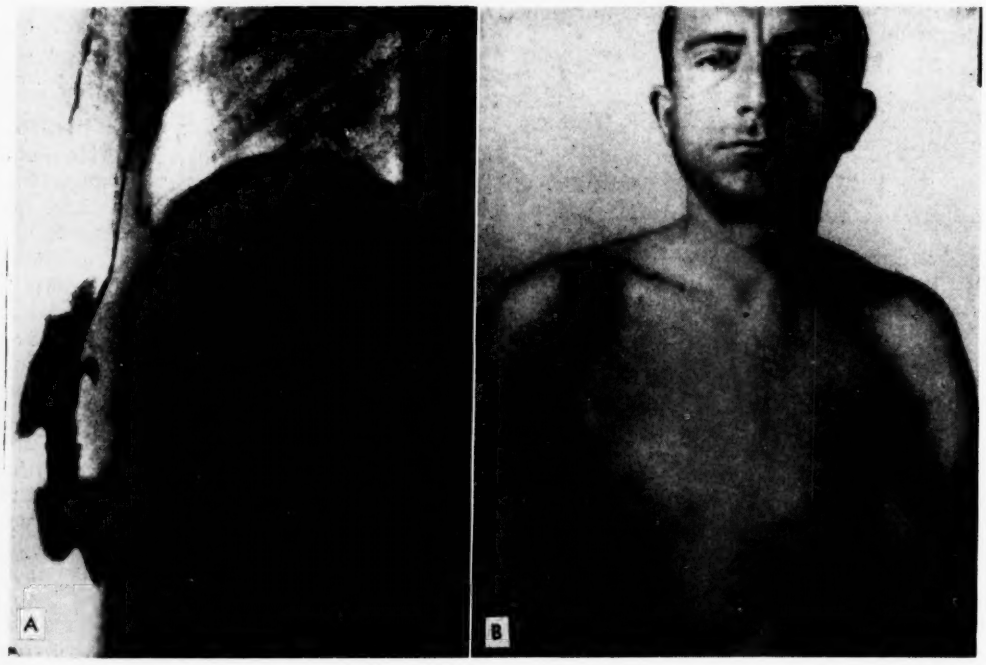

Fig. 6.—*A*, filling of the connecting loop. The already empty skin tube is outlined. *B*, completed esophagoplasty.

the cutaneous margin.

To proceed to the closing stage, the forming of the skin tube, is permissible only if both openings, the esophagostomy and the enterostomy, are sufficiently broad, and smooth, showing no signs of inflammation. The patient must have learned to swallow with the cervical portion of the esophagus in the new place, and the swallowed fluid must leave the esophagostomy in a strong arch (Fig. 4).

It must be clearly understood that, once the connection between the esophagostomy and enterostomy has been made, that is, the new esophagus has been completed, there is no possibility of further dilation. If there is a stricture, it must be cut out and the gap repaired.

The formation and function of the connecting skin tube is not at all hindered by the hairs. According to our experience the inverted hairs eventually degenerate and the skin lining is hairless. The skin tube is a connection between the esophagostomy and the enterostomy; hence the formation of the skin tube must be the closing stage and not the first, as it has been considered by some authors. With regard to the end result, the length of the skin tube does not matter. To adapt the esophagus and the intestine to a given tube is sometimes difficult and sometimes not even feasible. It is convenient if there is a low esophagostomy and a high enterostomy. Nevertheless, even if one must deal with a high esophagostomy and a low enterostomy, the skin connection is always feasible. A high esophagostomy will produce unesthetic scars on the neck. A connection with a low enterostomy is not quite so easy to perform, because of the hindering gastrostomy opening.

To insure with some certainty the smooth healing of the connecting skin tube, there are two requirements: The skin tube must be completely closed and covered with well-nourished skin flaps. The suture line of the skin tube and the covering skin must not lie in a corresponding line. If one abides by this rule, and later a fistula develops, the fistula will be an oblique one and will have a greater tendency to heal than does a straight one. There is no sure method of avoiding fistula formation. Fistulas form mostly around the esophagostomy, rarer around the enterostomy, and are very rare in connection with other parts of the skin tube. In the beginning, in some cases, we performed an end-to-end connection between the skin tube and the esophagus and the intestine respectively. Our later and standardized method is much simpler; we use for the anastomosis the surrounding skin of the esophagostomy and the enterostomy. It is simpler and surer, because we suture the same kind of tissue that is the skin. It gives more security for smooth healing.

The proper diameter of the skin tube is 2.5 cm.; therefore, we use for its formation a strip of skin 7 cm. wide. For children and for patients of delicate build we may be contented with a narrower strip. If a heavy dose of atropine sulfate is given preoperatively, the esophagostomy and the enterostomy will be kept dry. Moreover, they should be temporarily packed with iodoform gauze. We mark with compasses the 7 cm. below the enterostomy and above the esophagostomy and connect the two points, such having outlined the skin strip necessary for formation of the skin tube.

This stage can be also conveniently performed with local anesthesia. The infiltration is best done in stages; that is, only the region actually operated upon is infiltrated with 0.5 per cent solution of procaine hydrochloride. We infiltrate first the subcutaneous tissues between the two openings and make our incision according to the marked line. Starting from the skin margins of the strip, the latter will be only so far liberated as to permit the formation of a tube without tension. The hemostasis must be extremely careful. Throughout the whole plasty only the finest catgut is used. To gain sufficient strength for the sutures we suture in such a manner that we take into the sutures not only the subcutaneous layer but the deep part of the skin itself, without piercing the epithelium (Fig. 5*A*).

After the union of the midpart of the

tube has been completed, one starts with the lower connection. The enterostomy is always less infected than is the esophagostomy. After due infiltration of the subcutaneous tissues around the enterostomy, the two parallel incisions are continued, and surrounding the opening 1.5 to 2 cm. distant, in the manner of a laurel leaf. This part of the skin is mobilized as far as necessary for tensionless closing. Closure is performed in the manner of an envelope. Then the upper connection is made exactly like the lower one, except that the "laurel leaf" points upward (Fig. 5*B*). On finishing the skin tube one must change gloves and instruments. In some cases it is possible to cover the skin tube by cautious dissection of the margins of the neighboring skin without tension. First one closes the two end points, i. e., the connections, and only after that the midpart. For tension sutures we use four point stitches. One cm. from the margin we pierce in 1 cm. inward from the margin, coming out on the other side, then turn and pierce 1 mm. in from the margin again and come out 1 mm. from the margin of the other side. In such a way there is no tension on the skin margin, and the skin is brought broadly to adaptation. Between these sutures we close with fine silk stitches and if there is no tension at all on the end, we may cut out the tension sutures at the end of the operation. We may use the stitches tied on pieces of gauze. The weak point is that the inner and outer suture lines cross each other.

If this method is not feasible because of tension, we may mobilize the skin of the breast with two long incisions. The lower incision runs parallel with the costal arch, from the lowest point of the operative skin defect, in a direction opposite the gastric fistula, to the right. According to the tension of the skin, it may be 10 to 15 cm. long. The other incision runs from the uppermost point of the skin defect, i. e., on the neck, in an oblique direction downward to the left (Fig. 5*C*). In this way two large triangular flaps are obtained, which allow tension-free closure after dis-

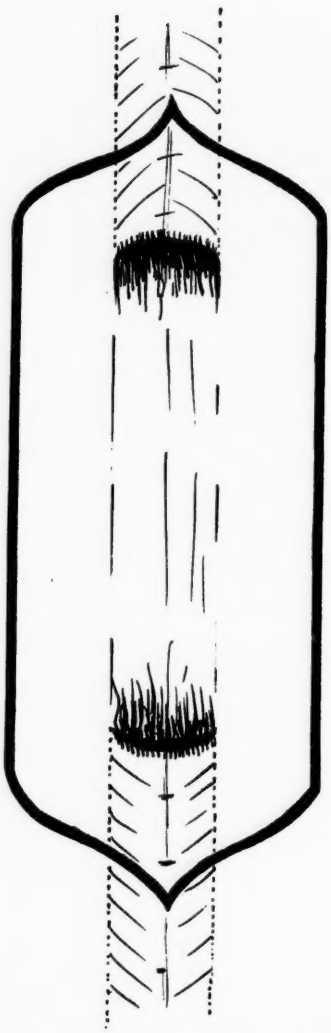

Fig. 7.—Repair of an extended area of loss of the skin tube.

section. The advantage is that the inner and outer suture lines coincide at one single point. If fistulas arise, they will be oblique, and will have more likelihood of healing spontaneously. With other kinds of flaps the result is uncertain. The same is true of grafting, even if the defect to be covered is small. Drainage must not be used. Hemostasis must be perfect. The

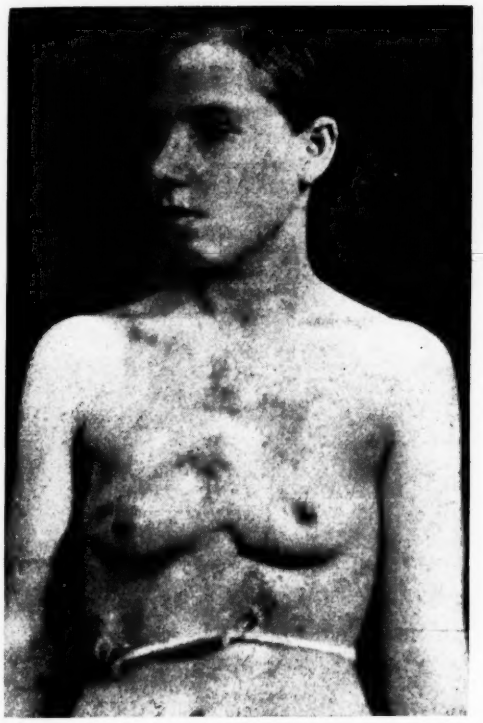

Fig. 8.—Considerable loss of the skin tube due to accident. Replaced with liberally cut sliding flaps.

skin lies snugly on the thorax, and there are no dead spaces. Primary healing is an exception, as is spreading infection. Mostly it amounts to a localized collection of pus; with the sacrifice of one or two stitches, healing is quick. Unfortunately a healing process so disturbed favors the occurrence of fistula.

The suture line is covered by mastix, and the arms are crossed and fixed on the thorax to give relaxation and rest to the skin.

For two days no food is given through the gastric tube. The gastric juice is drained out in order that it may not reach the skin tube and cause harm. After two days the patient is given fluids through the gastric tube. He must gargle frequently, using a weak N. A. B. solution, (0.45 in 2 pints of water, kept in a dark bottle). It is equally important to spit out the saliva. Atropine is not given; it dries the mouth, and in a dry mouth the germs thrive more vigorously.

Both when healing is primary and when fistulas are formed, feeding by mouth is started after fourteen days. Earlier oral feeding is inadvisable, because the food is a load for the suture line and the slight movements of the skin tube during deglutition presses the localized infection around the skin tube into the neighboring tissues. It is not wise to postpone feeding by fluids for more than fourteen days, because the fluids clean the skin tube and favor the healing of fistulas. During drinking, the fistulous openings are closed by the patient or by the nurse. First the patient is given weak tea without sugar; then gradually, other fluids, after which he should swallow a few sips of tea for cleaning purposes. In about two more weeks semisolid and solid foods are given. Extremely cold or hot fluids and spicy foods are not permitted even then. If the patient eats solid foods he should take small bites, chew well, and take some fluid between bites. After each meal the esophagus must be cleaned with a greater quantity of fluid. In general, the patient ought to eat frequently, but with the precautions indicated (Fig. 6).

There are two dangers: fistulas and stricture. To prevent fistula formation the skin tube must be sutured without tension and covered without tension in the same stage, and the two suture lines must not cross each other.

If fistulas are starting to form, strapping may be used. For fistulas in the upper part this procedure will not be particularly advantageous. One may achieve so much as to avoid opening greater parts of the plasty. It is of no use to scoop out the fistula and try to suture it. In the macerated skin the sutures will not hold, and in most cases such a procedure will be followed by enlargement of the fistula. The difficulty of healing is that the fistula is speedily covered with epithelium from within or without. Therefore, even with a small fistula, before strapping one should

cut out the epithelial covering with a small scalpel. In very small fistulas the epithelium can be destroyed by chromic or nitrous acid. Strapping follows.

For closing a fistula, small flaps cut out from the neighboring skin are useless. The neighboring skin is macerated, badly nourished and fibrotic. Larger fistulas or gaping parts of the tube can be closed only with sliding flaps from distant healthy skin parts. The surrounding skin is used for forming the inner wall of the tube, in the manner of a wing or door. If, because of insufficiency of the sutures or

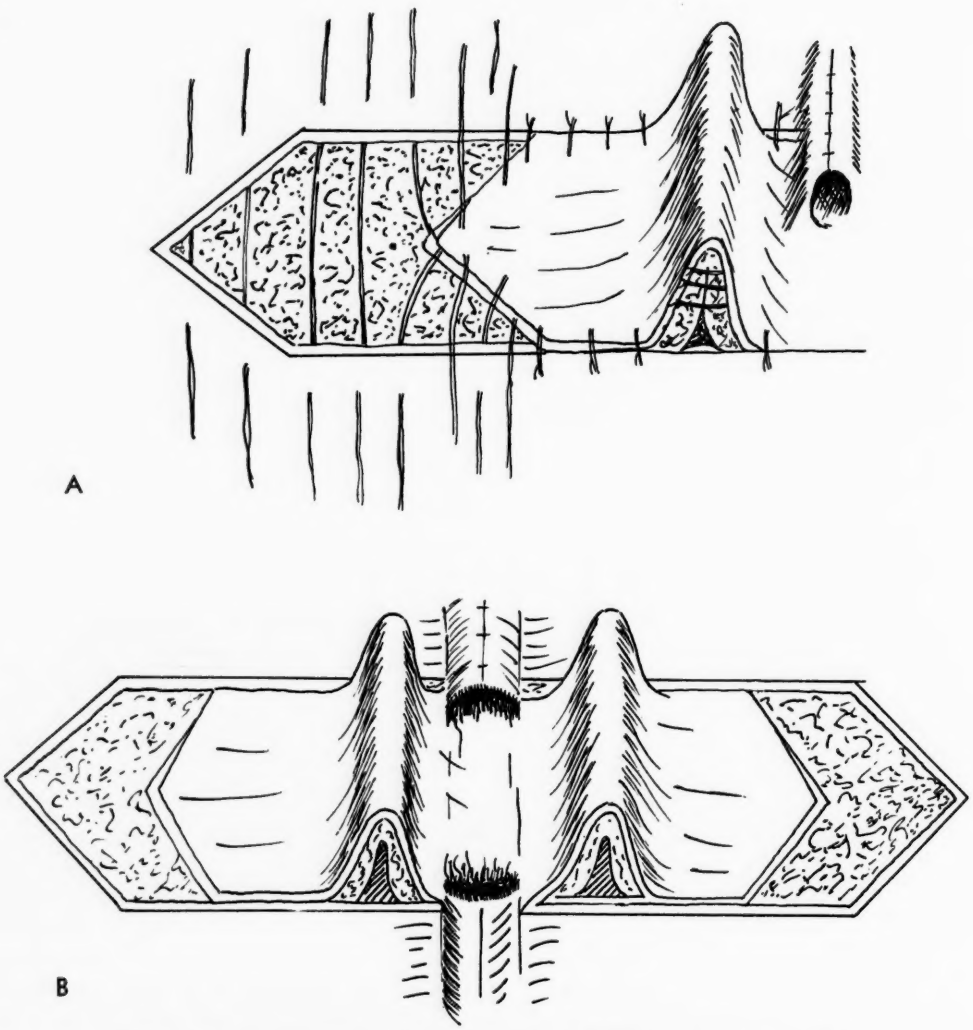

Fig. 9.—*A*, Gregoire's method for making the lower connection. *B*, repair of a defect in the skin tube by Gregoire's method.

excision of a strictured part, a considerable length of the skin tube is lost, the incision to form the replacement part must be placed on the covering skin of the remaining tube at the upper and lower end like a laurel leaf (Fig. 7). These two parts should be sutured like an envelope, as in covering the enterostomy or the esophagostomy. For covering one needs a sufficient amount of intact skin, which can be provided by liberally cut sliding flaps from distant healthy parts (Fig. 8). Pedicle flaps are rarely satisfactory. The sliding flaps of Gregoir are very useful, and we have employed it in our cases, always with success (Fig. 9).

A stricture cannot be relieved by bougienage. If it has formed it must be excised and the part covered either in the same stage or in a second.

We leave the gastrostomy open until the new esophagus, completely closed, has functioned for weeks without any difficulty. If the patient continues to swallow for four or five weeks without any difficulty and without the appearance of fistula or stricture, closing must be considered. If a correctly done fistula has not been too long in action, removing the tube, scooping out the epithelial covering of the fistula and skin strapping will bring about spontaneous closure. If the fistula is of long standing, the surrounding area is fibrosed because of the continuous inflammation. In such a case it is not likely that spontaneous closure will occur. The same is the case if the fistula is too broad or the mucosa is prolapsed. Still it is advisable to try spontaneous closure; at least the fistula will be narrower. Before the operative closure the heavily macerated skin must be improved. The best method seems to be to dry the skin—to leave it as far as possible without covering and to dry it with a hair dryer many times a day. On the day of operation we give a heavy dose of atropine sulfate. We have been forced to close the fistula when the skin was still macerated; nevertheless, we have not encountered any trouble in wound healing. If possible the closure must be made extraperitoneally.

Most of the patients have an inactive form of tuberculosis of the lungs; therefore complications referable to the respiratory system are the most frequent. The complications are a greater threat to the result of the plasty than to the life of the patient. One of our patients had highly toxic paratyphoid between two stages; another had pneumonia. During the complicating disease, fistulas developed on the endangered spots. We could close them only long after the complicating disease was healed.

We operated on 25 patients. Seven were operated on by Prof. Borsos in the First University Surgical Clinic in Budapest and 10 by myself. Eight have been operated on in the Surgical University Clinic in Kolozsvár. We lost 3 of the 25 patients. In 1 case the connecting intestine became gangrenous. Reoperation was done, but the patient died subsequently from peritonitis. The second patient had benign fibrotic pulmonary tuberculosis. After the first stage the tuberculosis flared up, and she died of caseous pneumonia. The third patient was a young married woman who was very much undernourished. The first stage went smoothly. The drainage tube in the mediastinum was taken out on the eighth postoperative day, and the patient left the bed and walked around. Nevertheless her condition deteriorated visibly. On the tenth day bleeding started from the mediastinum through the opening for the drainage tube. The patient lost about 300 cc. blood. The bleeding was stopped by packing the course, and a corresponding amount of blood was administered. Despite this, however, the patient died, showing symptoms and signs of failure of circulation. A postmortem examination was done. The bleeding vessel could not be identified. No bleeding was observed in the surrounding tissues. Central bronchopneumonia was the only pathological change. Apparently the patient was in such a low condition that she could not bear the damage of bronchopneumonia and of the blood loss; indeed, she could not even respond with temperature suffering from bronchopneumonia.

Two other questions must be answered: How long does it take to finish the reconstruction of the esophagus, and what are the final results? In exceptional cases the time can be surprisingly short. We have had a patient who left the clinic without fistulas in eight weeks. In some cases we finish the reconstruction in three months' time. The average time, including the time required to close the fistulas, was six months. When there were serious complications the healing period lasted up to a year. We could observe the forming of fistulas many months after influenza or pregnancy. Operative closure of such fistulas did not involve any special difficulty. The patients remain in contact with the clinic. At the time of writing, all of them are in good physical and mental condition and are working. Two of them have married each other. One was delivered without any complications from the site of the newly formed esophagus.

SUMMARY

The author demonstrates the actual importance of extrathoracic esophagoplasty and outlines the history of its development.

Twenty-five consecutive patients have been operated upon, 20 by a modified Lexer procedure. Esophagodermatojejunogastrostomy was carried out. Of the 25 patients, 3 died.

The operative technic and the suitable local anesthetics are described. The operation, in the author's opinion, is preferably done in stages.

ZUSAMMENFASSUNG

Der Verfasser stellt die Bedeutung der extrathorakalen Oesophagoplastik dar und gibt einen Überblick über die Geschichte der Entwicklung des Verfahrens.

An einer ununterbrochenen Reihe von 25 Kranken wurde die Oesophagodermatojejunogastrostomie ausgeführt, an 20 von diesen Fällen mit einem modifizierten Lexerschen Verfahren. Von den 25 Kranken starben drei.

Die Operationstechnik und geeignete örtliche Betäubungsmittel werden beschrieben. Der Verfasser ist der Meinung, dass die Operation am besten in mehreren Stadien ausgeführt wird.

RÉSUMÉ

L'auteur démontre la réelle importance de l'oesophagoplastie extrathoracique et décrit l'histoire de son développement.

25 malades ont été opérés dont 20 par la méthode de Lexer, modifiée. On pratiqua une oesophagodermatojejuno-gastrostomie. Sur les 25 cas opérés, trois moururent.

L'auteur décrit la technique opératoire et l'anesthésie locale. D'après l'auteur, il est préférable de pratiquer cette intervention en plusieurs temps.

RIASSUNTO

L'autore dimostra l'importanza dell'esofagoplastica extratoracica e ne sottolinea la storia del suo sviluppo. Furono operati 25 pazienti, 20 dei quali con la tecnica di Lexer modificata. Si praticò la esofagodermato-digiunogastrostomia. Su 25 pazienti ne morirono 3. Vengono descritte la tecnica operatoria e l'anestesia locale che più si addice. Secondo l'opinione degli AA. è preferibile che l'operazione venga fatta in più tempi.

RESUMO

O autôr descreve a historia de desenvolvimento da plastica esofagiana por via extra-toracica, demonstrando o valôr atual dêsse metodo cirurgico.

Vinte e cinco doentes foram operados, sendo que 20 pelo processo de Lexer modificado, falecendo, do total, apenas 3 pacientes.

A técnica cirúrgica e a maneira de se processar a anestesia local são descritas,

salientando o autôr que a operação deve ser preferentemente praticada em diversos tempos.

RESUMEN

El autor demuestra la importancia actual de la esofagoplastía extratorácica y delínea su historia y desarrollo.

Dicha intervención ha sido practicada en 25 pacientes consecutivos, 20 por la técnica de Lexer modificada. Esofagodermoyeyunogastrostomía. De los 25 pacientes murieron 3.

Se describen la técnica operatoria y la anestesia local adecuada. En la opinión del autor es preferible practicar la operación en dost miepos.

After all, a little good taste does no harm, and the fever of perfection is catching.

If with an excess of interest you peer into the lives of others, what you will probably find is that you have to pay their debts.

All mirrors are magical mirrors, and we never see our faces in them.

It is just as well to be a little giddy-pated, if you are to feel at home on this turning earth.

Amid the vast unimportance of all things, how beyond all calculation important we find it each morning to have at hand—in the face of Time and Eternity and the starry spaces—an adequate supply of thin paper!

Solvency is entirely a matter of temperament and not of income.

The world, as I know from books, is full of abominable evil;—indeed, I myself, not many years ago, had some collars stolen in the wash.

I might give my life for my friend, but he had better not ask me to do up a parcel.

—*Smith*

Impending Death Under Anesthesia**

MAX THOREK, M.D., F.I.C.S.*

CHICAGO, ILLINOIS

CARDIAC arrest during anesthesia is the most terrifying emergency of the surgeon's career. Mastery of the situation demands a split-second decision and instantaneous action by the surgeon and the anesthetist, who must work together according to a well-defined plan.

Until recently the patient had hardly more than a 1:1,000 chance for survival. My attention was focused on this grim fact in June 1948, when the emergency occurred in my service. The fact that my associates and I were able to snatch the patient from the very jaws of death and that she eventually recovered all of her physical and mental faculties demonstrated vividly what quick action and precise teamwork can accomplish.

Many similar cases have since been reported. I have, therefore, undertaken to assess what has been accomplished in this highly specialized field during the past five years.

Incidence of Cardiac Arrest.—Palomera reviewed the literature on cardiac resuscitation in October 1952. He referred to Barber and Madden, who had collected 143 cases from 1848 to 1945. Dillon has noted that 6 deaths due to cardiac arrest occurred among 28,000 administrations of anesthetics between July 1946 and April 1948 in a general hospital. At the Lahey Clinic, 7 cases had occurred in thirteen years. Hamilton Bailey had reported approximately 2 cases a year; Cooley, 48 cases among 878 patients operated upon for pulmonic stenosis. Palomera commented that the true incidence is not easy to obtain, since few failures are reported. Cardiac arrest is most frequent during intrathoracic operations, especially upon the heart and great vessels.

Ament observed that 29 cases of cardiac arrest occurred among 28,000 major procedures at Bellevue Hospital in New York City, and Johnson encountered 20 cases during a three-year period at the Pennsylvania Hospital in Philadelphia. Eight of his patients had cardiac arrest after they had been returned to bed. Becker reported the frequency of sudden death in the operating room to be about 1 in each 1,000 cases of anesthesia administered.

In the last ten years, 11 cases of cardiac arrest have been observed at the American Hospital in Chicago. Five of these were in the practice of Dr. Philip Thorek and 6 in my own service. Of the 11 patients, 6 were saved by cardiac massage and 5 died.

Dr. J. William Hinton, Professor Surgery at New York University, has reported an increase in the incidence of sudden cardiac arrest, basing this statement on 1,344 cases throughout the United States. This includes cardiac standstill and ventricular fibrillation, and in Hinton's opinion the increase is due to (1) wider use of combined synthetic drugs and (2) the increase in the number of diagnostic studies requiring anesthesia. The survival rate for the 1,344 cases was only 28 per cent.

Hinton has also observed that 20 per cent of patients with cardiac arrest were under 10 years of age and that the incidence showed an abrupt decline in the years thereafter until the age of 40. It was noted that, whereas children normally have highly sensitive reflexes, this sensitivity gradually decreases with age, and, accordingly, the incidence of cardiac arrest declines. In the older age group, age-period changes in the vascular tree or lesions in the specific tissue seem to render the heart

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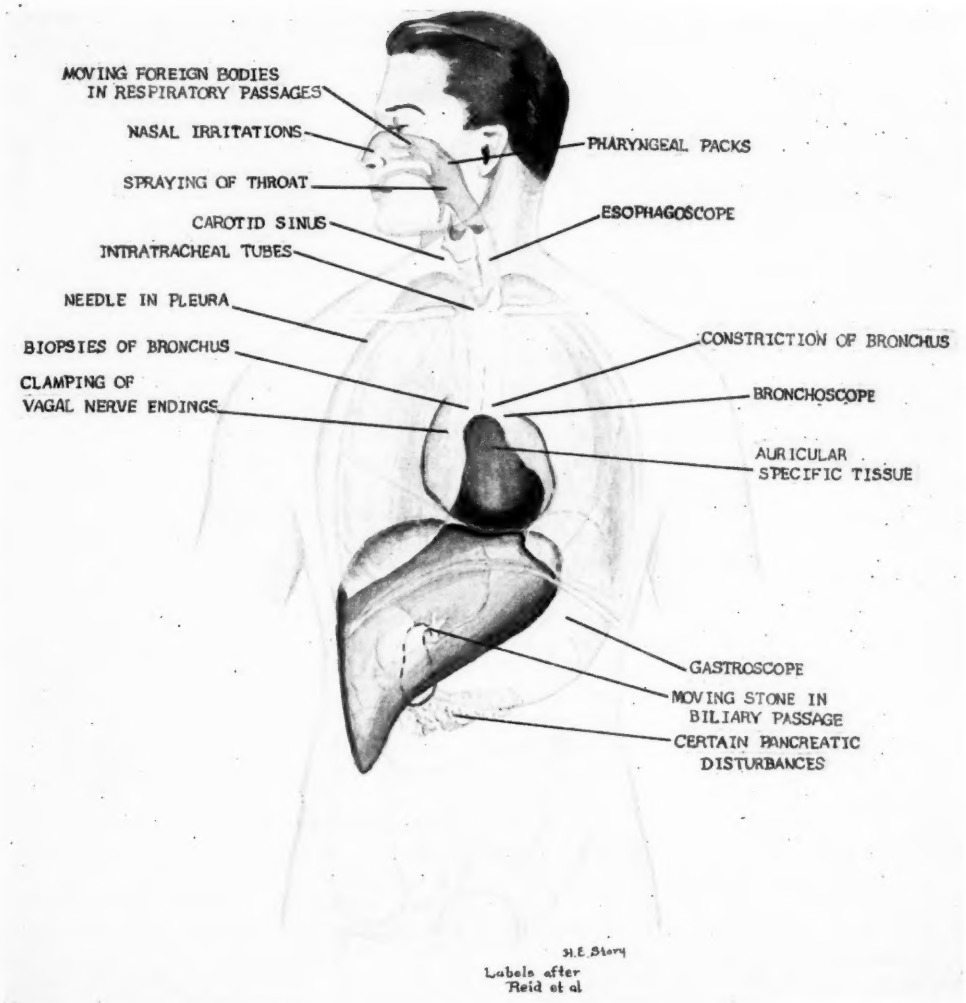

Fig. 1.—Reflex areas from which cardiac arrest may eventuate.

increasingly vulnerable to vagal stimulation. Ventricular specific tissue seemed more depressed under the conditions that promote cardiac arrest when stimuli were initiated under the influence of anesthetic agents. Though at such times an undesirable reflex is not so likely to be set up, if it occurs it is more serious and more obvious than it would be in younger persons, in whom more active ventricular specific tissue is present.

Etiologic Factors. — Why one patient carefully examined and prepared preoperatively should pass through anesthesia and operation without incident, while another, who is apparently as good an operative risk, should undergo cardiac arrest remains a mystery. Existing disease of the heart and lungs naturally makes arrest more likely. Also, the incidence is greatly increased by any type of cardiac surgical procedure. Cardiac complications may be

expected more frequently in poorly nourished patients because of decreased glycogen reserve.

Cardiac and respiratory arrest may be (1) reflex (Fig. 1), due to vagovagal stimulation; (2) traumatic, due to injury to the heart or pericardium during operation; (3) the result of functional abnormality, such as ventricular fibrillation from an oversupply of epinephrine, either injected or secreted by the adrenal glands, or (4) induced by faulty selection or an overdose of the anesthetic.

Palomera listed eight significant etiologic factors: (1) myocardial deficiencies, especially those associated with areas of myocardial ischemia; (2) hormonal and chemical influences, such as excess of epinephrine, hypoglycemia, excess of pituitrin, variations of blood potassium, oxygen deficiencies and increase of carbon dioxide in the blood; (3) nervous influences; (4) hemorrhage; (5) actions of bacteria and toxins; (6) action of anesthetic agents; (7) action of barbiturates, and (8) pyrogenic and transfusion reactions.

Becker mentioned the preoperative mental state of the patient as an important etiologic factor. Strong emotions, such as fear, bring about an increased output of epinephrine, and some additional stimulus during the administration of even light anesthesia may induce ventricular fibrillation. Anemia may contribute to cardiorespiratory failure by increasing the degree of anoxemia and its attendant—hypoxia—which increases the sensitivity of the heart to acetylcholine. If vagovagal reflexes are initiated during an operation, acetylcholine is produced at the neuromyocardial junctions. If the cardiac sensitivity to acetylcholine is increased or the circulating cholinesterase decreased, the heart slows or stops. Thus, the surgeon, working in any area in which reflexes can be produced whose efferent pathways are through the vagi, may inadvertently bring about cardiac arrest by promoting an excessive production of acetylcholine.

The indiscriminate use of a variety of drugs is a potent factor in cardiac arrest. Both Dinsmore and Beecher commented on this fact, and Beecher stressed the role of muscle-relaxant drugs of the curare-like group.

Bonica classified acute cessation of cardiac activity into two convenient types: (1) arrest of stimulus formation (the so-called pacemaker failure), the result of which is cardiac asystole or standstill, and (2) electrodynamic dissolution of the cardiac cycle, as in ventricular fibrillation. Nelson and his associates stated that low oxygen levels in the blood stimulate the carotid sinus and the cardioinhibitory reflexes. A low oxygen content and a high carbon dioxide content each cause oversecretion of epinephrine. Hypoxia sensitizes the myocardium to epinephrine. These factors favor either fibrillation or standstill. Beck and Mautz indicated that general lack of oxygen usually causes cardiac standstill, while focal hypoxia of the myocardium favors fibrillation.

Relation to Spinal Anesthesia: As spinal anesthesia has been increasingly employed in recent years, more and more operating-room deaths have been charged to its account. There is no doubt that this technic, despite its immense and undeniable advantages, has complicated the problem presented by cardiac arrest. Babcock declared the ratio to be as low as 1:10,000, but other observers have placed it as high as 1:1,000. The exact mortality rate no doubt lies somewhere between these two extremes. It would seem to be an established fact that, other conditions being the same, more patients die under spinal anesthesia than would be likely to die under other types. The incidence of death under spinal anesthesia is apparently greatest among aged persons, so-called "poor operative risks" and Negroes. Seemingly, for young and healthy persons, a spinal anesthetic presents no greater hazard than any other.

Genesis of Cardiac Arrest.—Much confusion still exists among surgeons concerning the genesis of cardiac arrest. Ventricular fibrillation seems rare in comparison with the number of cases of cardiac arrest.

It has been stated that there is no specific tissue in the heart. Yet every few

years the discovery of a new area with specific tissue characteristics is announced (Fig. 2). What is the "specific tissue"? There is no absolutely reliable anatomically distinguishing feature, but it is known to be the hardiest tissue in the body and can function for long periods without oxygen or even blood supply. Its capacity for automaticity is the outstanding feature, and every one of the millions of specific tissue fibers is in itself able to form a stimulus. The law of auxomeric conduction states that, as long as one healthy fiber of this tissue is present, conduction will be normal. The specific tissue is susceptible of revival to good function as long as seventy-two hours after death. In clinical terms, this means that widespread disease may exist in the specific tissue which, under ordinary conditions, might readily escape detection.

The distribution of the vagus in the specific tissue is restricted to the auricles. There are no vagal fibers in the mammalian ventricles. The specific tissue has the capacity to originate stimuli and is widely distributed throughout the auricles and ventricles. In a normal, healthy heart, no stimulus from any source, including the carotid sinus, can cause a general collapse, because the specific tissue in the ventricles, being free of vagal influences, can form stimuli and function autonomously and, as far as the circulation is concerned, in a perfectly satisfactory manner.

Anesthesia depresses the capacity of the specific tissue to form stimuli, and it responds to vagal stimulation as if there were widespread lesions with nonfunctioning elements. In other words, a heart under anesthesia is as vulnerable to vagal stimulation as would be a heart with widespread organic disease in the specific tissue without anesthesia.

Anoxia *per se* will not cause or initiate these reflexes, but its presence enormously potentiates the action of the anesthetic agent, with a still further depression of the capacity of the specific tissue to form stimuli.

The following case, together with others which have been reviewed, presents convincing evidence that cardiac and respiratory arrest during anesthesia is amenable to control under proper conditions when adequate technical skill is available and promptly applied.

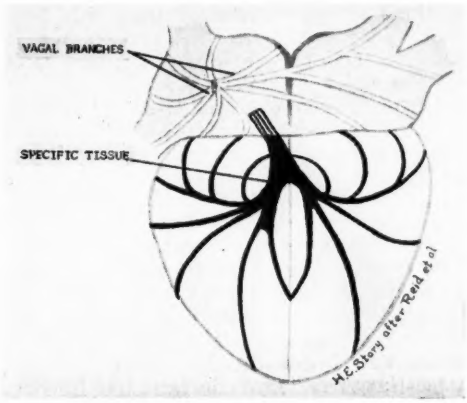

Fig. 2.—Distribution of "specific tissue" in mammalian ventricle.

REPORT OF A CASE

A married woman aged 23 was admitted to the American Hospital on June 25, 1948, to be operated upon for chronic appendicitis. Prior to the administration of the anesthetic, the blood pressure in millimeters of mercury was 120 systolic and 800 diastolic. Premedication included the administration of 1½ gr. of nembutal two hours before operation and ⅛ gr. of morphine sulphate with 1/200 gr. of scopalamine one hour later. Except for the appendicitis, the patient gave no evidence of organic disease.

Spinal anesthesia was employed, 14 mg. of pontocaine with 1 cc. of 10 per cent dextrose solution being injected into the subarachnoid space at the level of the third and fourth lumbar segments. The anesthesia reached the level of the eighth thoracic segment (the anesthetist stated afterward that it could not have risen above this level). On the table, the patient appeared apprehensive and was restless and uncooperative.

Intravenous injection of 0.4 per cent solution of pentothal sodium into the ankle vein was begun not less than ten minutes after administration of the spinal anesthetic. A total of 0.35 gr. of pentothal was administered by the continuous drip method over a period

of three to five minutes. During this time, the blood pressure was 100 systolic and 60 diastolic. One minute later, it dropped to 60 systolic and 0 diastolic.

The pentothal was discontinued and the blood pressure checked. It was 40 systolic and 0 diastolic. One-half minute later the systolic pressure had also disappeared. The patient was still breathing shallowly, but with apparently fair exchange. Her face was livid, and no carotid pulse could be detected by palpation.

Pure oxygen was immediately administered by mask. A check for the aortic pulse was without result. I immediately opened the diaphragm through a left superior rectus incision and began cardiac massage, at the same time ordering an intracardiac injection of epinephrine (0.5 cc., 1:10,000). Massage had been continued for five or six minutes before the heart resumed spontaneous activity. During this time the patient, whose respirations had now also ceased was intubated and artificial respiration with pure oxygen begun. Administration of 5 per cent dextrose in water was started in the foot and the apparatus set to run as rapidly as possible. When the heart action was firmly reestablished, appendectomy was carried out through the incision already made. The total period of cardiac arrest was nineteen minutes.

The patient remained in coma four days, giving no response to painful stimuli; the pupils were fixed and dilated, and a classic Magnus de Kline phenomenon, as well as a continuous bilateral Babinski sign, was present. On the day of operation one had gained the impression of cortical degeneration secondary to cerebral anoxia. A bilateral stellate block was performed and was repeated on each of the two following days.

On the first postoperative day, spinal puncture yielded normal fluid under a pressure of 280 mm.; the coma seemed even deeper.

On the second postoperative day the patient was still in deep coma, but not quite so oblivious as before. On the third day her condition was worse, with repeated vomiting. On the fourth day the sensorium was slightly clearer, and on the fifth there was definite, if slight, improvement. By the end of the seventh day she had regained full consciousness, although motor weakness was still marked in the extremities. The reflexes remained unchanged.

On the seventeenth postoperative day the patient walked with assistance, though her gait was staggering and insecure and her gaze fixed on the ground. Babinski and Gonda signs were still marked on the left, but less pronounced on the right.

Thereafter, her progress was steady. On the thirty-second postoperative day she had so improved that her discharge from the hospital was considered; she could walk alone and was steadily gaining strength. On discharge from the hospital, her mental condition was still somewhat befogged and her speech hesitant, but thereafter improvement was constant. By November, the finer movements of the extremities were completely restored, and her speech was practically normal. She was then two and a half months pregnant, her gestation proceeding without untoward manifestations of any kind. Her delivery, after three hours of labor, was without incident; no anesthetic was used. The boy weighed 7 pounds and 7 ounces (3,373 Gm.) and was healthy.

Biochemistry of Brain Damage.—It is known that nerve cells of the brain are more sensitive to lack of oxygen than are any other body cells. The general attitude has been that the remote effects of cerebral damage due to anoxia are irreversible and that the extent of damage will always be determined by the length of time the brain is deprived of oxygen. The generally accepted dictum has been that the brain will not stand more than five minutes of oxygen deprivation without sustaining irreparable injury.

Yet, in my review of recent literature on cardiac arrest, I found some cases in which complete restoration of brain function took place when the period of arrest had been considerably in excess of that time limit. In the case reported by James C. Fox, Jr., there were twenty-seven minutes of ventricular fibrillation, but there was no permanent injury to the brain. In my own case the heart was arrested for nineteen minutes; the postoperative course was stormy, yet recovery apparently was complete.

McGinty and Gesell noted that during the first four minutes the lactic acid content of the brain was doubled and that after about ten minutes it was increased to a maximum of two and one-half times the normal. This local acidosis, in their opin-

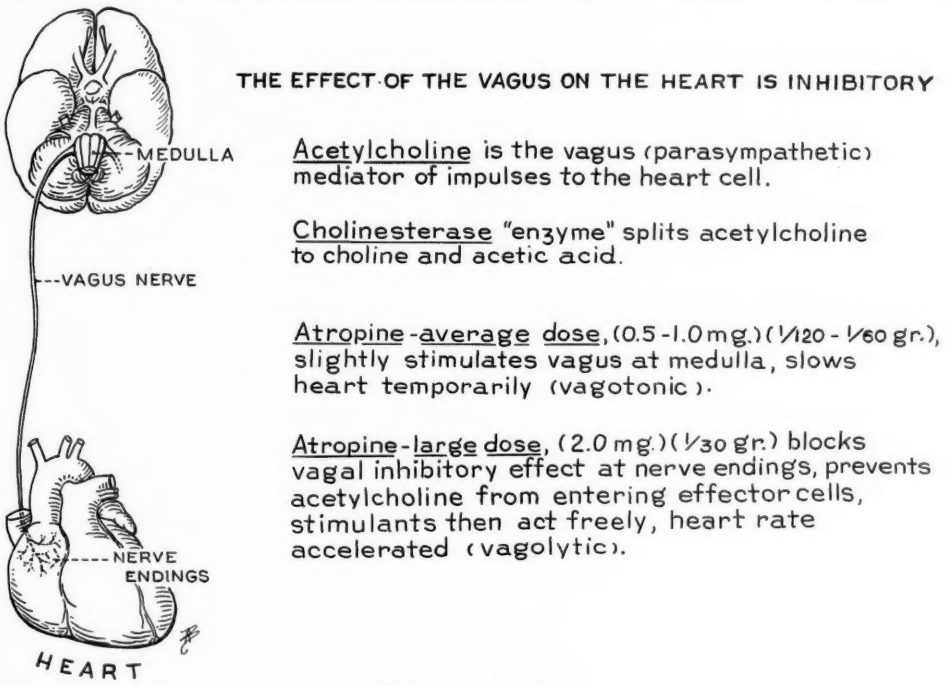
THE EFFECT OF THE VAGUS ON THE HEART IS INHIBITORY
MEDULLA
VAGUS NERVE
NERVE ENDINGS
HEART
Acetylcholine is the vagus (parasympathetic) mediator of impulses to the heart cell.
Cholinesterase "enzyme" splits acetylcholine to choline and acetic acid.
Atropine-average dose, (0.5-1.0 mg.) (1/120 - 1/60 gr.), slightly stimulates vagus at medulla, slows heart temporarily (vagotonic).
Atropine-large dose, (2.0 mg.) (1/30 gr.) blocks vagal inhibitory effect at nerve endings, prevents acetylcholine from entering effector cells, stimulants then act freely, heart rate accelerated (vagolytic).

Fig. 3 (see text).

ion, plays an important part in the proteolytic process of the ganglion cells. Another investigator demonstrated that anoxia damages nerve cells at the outset by acute demineralization. There follows a slow return to normal, requiring from two to three months.

Haglund reported the following case:

A girl aged 15 months was given open-drop ether anesthesia for removal of a screw from the left main bronchus. The foreign body was easily located and grasped with tongs, but it was impossible to draw the screw head into the bronchoscope. The surgeon attempted to withdraw the instrument and the screw simultaneously, but the screw head was impacted between the vocal cords, which went into acute spasm. The patient made one or two gasping, violent respiratory efforts and then lay flaccid, the ashen-gray color of her skin indicating the possibility of cardiac standstill provoked by acute anoxia and intense vagovagal reflexes. Tracheotomy was at once performed and artificial respiration with pure oxygen administered. Epinephrine was injected intracardially, but not until nine minutes had elapsed was the chest opened and a "flaccid, dilated heart" palpated. After no more than one minute of cardiac massage, spontaneous heart action was restored. Spontaneous respiration was resumed ten minutes later.

The patient remained in deep coma, and after five hours the body temperature rose to 39.5 C. The pyrexia was combated by cool sponging, with the administration of antipyretics in small doses. The patient's condition remained almost unchanged for many days, but "little by little 'normal' reactions increased." After seven weeks, the child cried and made deprecating gestures when disturbed by moving, pinching, feeding and so on. After ten weeks she "probably reacted to sounds" but not to light. An electroencephalogram showed increasing cerebral activity. In two more months there was continued regression, according to the electroencephalogram, but after six months the clinical picture was unchanged and tube-feeding was still necessary.

Fox's case, as well as my own, indicates the possibility that brain changes

are reversible. In his case the visual and sensory cortices were particularly vulnerable to the injurious anoxic effects, as was shown by severe and prolonged loss of vision and marked astereognosis. It would seem that the so-called "higher" centers are more easily injured by being deprived of oxygenated blood than are the lower ones. Proof of this was offered by Lennox, Gibbs and Gibbs in 1937, when they showed that their subjects became unconscious when oxygen saturation of the blood in the jugular vein fell below 24 per cent, whereas the lower centers continued to function. Other evidence supports the facts of a decrease in the metabolic rate and a gradient in vascularity as the neuraxis descends from the cortex of the brain to the spinal cord.

Weinberger and the Gibbons, in 1940, made histologic studies of the brains of cats subjected to circulatory arrest lasting seven and one-half minutes. They demonstrated that the motor and visual areas of the cortex sustained the earliest and most profound damage. The olfactory, orbital and temporal regions of the cortex were least affected. Their experiments showed that if cardiac arrest is promptly and effectively handled, and the heart revives, it is unlikely that the brain will suffer irreparable damage. The condition is in striking contrast to cerebral anoxia due to carbon dioxide poisoning or an overdose of narcotic drugs. Here the pathologic changes have a greater tendency to be irreversible, being characterized by widespread foci of necrosis and degeneration involving the corpus striatum.

Prophylaxis.—Adequate oxygenation at all times is a "must" in the prophylaxis of cardiac arrest. Prompt treatment of arrhythmias, likewise, is all-important. This is done by the use of procaine or "pronestyl" and atropine. The two agents will help to counteract the arrhythmias that are usually the precursors of cardiac arrest. Since vitamin B complex is unusually important for smooth cardiac function in any state of deficient nutrition, its adequate preoperative use is most valuable. During any endocrine imbalance, such as accompanies the climacteric, substitution therapy is a good preoperative measure, and if there is any disturbance in cardiac dynamics such therapy is essential.

Effects of Vagus (Fig. 3).—(1) The effect of the vagus on the heart is inhibitory; (2) vagus (parasympathetic) mediator is acetylcholine; (3) cholinesterase enzyme splits acetylcholine to choline and acetic acid to become inactivated at a slow rate compatible with normal physiologic action; (4) atropine can prevent acetylcholine from entering effector cells; (5) atropine alters cardiac rate; (6) biphasic action on heart: *vagotomic* a) 0.5 to 1 mg. (1/20 to 1/60 gr.), average dose, slightly stimulates the vagus at the medulla to slow the heart rate temporarily; *vagolitic* b) 2 mg. (1/30 gr.), large dose, blocks the vagal effect at the nerve endings on the sinoauricular pacemaker and causes acceleration of the heart rate; (7) influence of large doses of atropine is always most noticeable in healthy young adults in whom the influence of the vagus on the cardiac pacemaker is at its peak—in infants and aged persons large doses of atropine may fail entirely to quicken the heart rate; (8) adequate doses of atropine will remove the heart from vagal control and lessen the degree or halt heart block in which a vagal component exists as an etiologic factor; (9) toxic doses of atropine, on the other hand, may in themselves cause V-A block.

Diagnosis.—The effects of an abrupt interruption of cerebral blood flow are due to anoxia, hypoglycemia and an increase in extracellular potassium induced by anoxia; these all contribute to impairment of function. Among the early warning signs are changes in cardiac rhythm, reduced oxygen tension of the blood and an increase in the rate and depth of the patient's respiration. Later, breathing becomes labored, the accessory respiratory muscles being used, and cyanosis may then be detectable. Initially there may be a rise in blood pressure, but this is followed by a steady decline, with sudden vasodilatation.

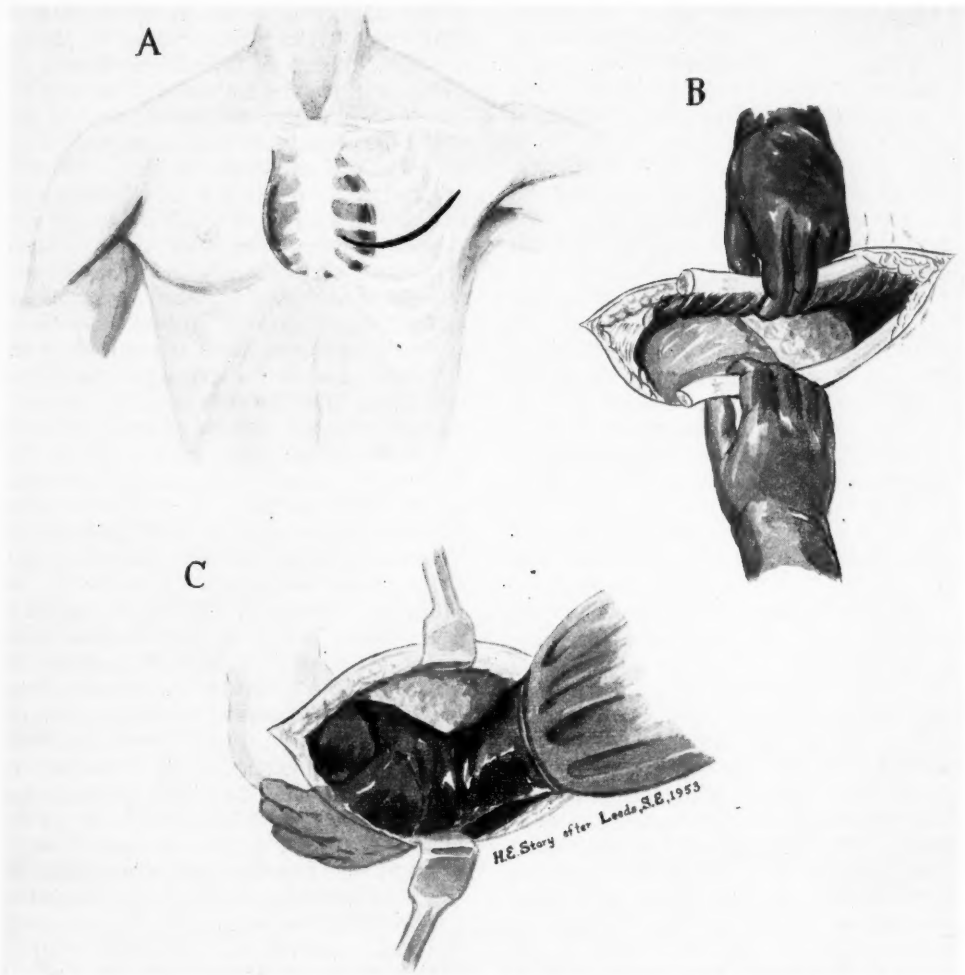

Fig. 4.—Transthoracic approach to heart in cases of cardiac arrest. *A*, incision; *B*, widening area of approach; *C*, cardiac massage.

The chief signs and symptoms of cardiac arrest are: (1) stoppage of breathing; (2) disappearance of pulse beat, blood pressure and cardiac sounds; (3) absence of bleeding in the operative wound, and (4) pallor or cyanosis. If anoxia is far enough advanced, the pupils may be dilated.

The stoppage of respiration is usually the initial symptom. When this is noted, the anesthetist should immediately feel the pulse to determine the state of the circulation. If the surgeon has access to one of the large arteries, he should test it by palpation; similarly, if the abdominal or thoracic cavity has already been opened, he should palpate the heart from below (abdominal incision) or examine it by direct observation (thoracic incision).

Direct observation, either of the heart itself or of one of the great arteries, is the only certain way to answer the one

all-important question: Has the heart actually ceased to beat? Visualization of the retina, often advocated, involves the time-consuming use of the ophthalmoscope and is less certain in its results. Electrocardiographic tracings are not to be relied upon. The same may be said of the absence of capillary refill (often difficult to evaluate, especially in dark-skinned persons). The carotid pulse usually gives the most reliable information.

Treatment.—During the short period in which cardiac arrest can be diagnosed and emergency treatment begun, an adequate supply of blood must be furnished by cardiac massage and oxygenation of the blood by ventilation of the lungs. The importance of oxygenation cannot be overstressed. It is best accomplished by intermittent full distention and deflation of the lungs at the rate of 20 to 30 times per minute, preferably with an intratracheal catheter. With rhythmic compressions of the rebreathing bag, caution must be exercised not to use excessive pressure (preferably not over 16 mm. of mercury) lest damage to the lungs be encountered. If other means are not available, mechanical compressions of the chest with traction on the tongue, or even direct insufflation with the mouth over the cupped hand, should be used. The patient should be placed in slight Trendelenburg position to facilitate circulation. Artificial respiration, however, is useless unless the circulation is maintained. Cardiac massage is, therefore, an all-important factor in the treatment and must be started without delay. The institution of massage within three and a half minutes after the onset of cardiac standstill will successfully prevent irreversible damage to the brain, provided adequate oxygenation is maintained. The critical feature is the prevention of damage to the central nervous system by prolonged hypoxia. Conversely, it is believed that the interruption of blood flow through the brain for more than three to four minutes is likely to produce brain damage so great as to be incompatible with the preservation of life.

The approach to the heart has three routes: (1) transperitoneal subdiaphragmatic, (2) transperitoneal transdiaphragmatic and (3) transthoracic. The third, which is achieved by an incision in the fourth left costal interspace, with division of the costal cartilages above and below, gives the widest and most direct access to the heart (Fig. 4). However, it embarrasses pulmonary ventilation because of collapse of the left lung in the absence of a closed anesthetic system or respirator, and it takes longer for a surgeon without special training in thoracic work. For the general surgeon, the transperitoneal approach through the upper median or paramedian incision usually affords adequate exposure of the heart, is more familiar and may be more rapid. If the chest has already been opened, the location of the operative exposure will guide the surgeon.

In the emergency of cardiac arrest, clean hands and a keen knife are the essentials. Disregard skin preparations; act without delay. In the transthoracic approach, as stated, the incision should be made in the left fourth interspace, from the edge of the sternum to the posterior axillary line. There will be no bleeding. Carry the incision rapidly through the chest wall and pleura and, by introducing the hand between the fourth and fifth ribs, get to the heart. In the state of asystole the heart is flabby and motionless; in the state of ventricular fibrillation the heart will feel not unlike the proverbial "bag of worms."

In the treatment of ventricular standstill, Kay emphasized that injecting a stimulant without benefit of previous cardiac massage often brought on ventricular fibrillation, but after a few minutes of massage the injected substance was in the coronary vessels and in the myocardial bed. Massage prior to the injection increased the possibility of restoring the normal beat by means of the injected drug, as well as of preventing the occurrence of ventricular fibrillation. To obviate the danger of ventricular fibrillation, according to Barber and Madden, the injection

should always be made into the right auricle. I have found 2 to 4 cc. of 10 per cent calcium chloride the most effective cardiac stimulant. But in Kay's experience, epinephrine hydrochloride almost always restored a normal beat, and when the first injection failed a second injection of the same strength was usually effective. It would seem safer to use a small dose of epinephrine hydrochloride and repeat the dose, or increase it if necessary, rather than to inject a large dose immediately and thereby run the risk of producing ventricular fibrillation.

In his experimental work, Kay considered that the most effective method of cardiac massage was as follows: With the operating surgeon on the left side of the table, the pericardium open and the left hand inserted through the left fifth interspace, the fingers are placed on the right side of the heart and the thenar eminence on the left side. The heart is then squeezed deliberately and firmly at a rate of 35 to 50 times a minute, which is rapid enough to maintain adequate circulation, yet does not tire the surgeon's hand.

If the surgeon has made his diagnosis without direct visualization of the heart, it may be advisable to try the maneuver suggested by Hamilton Bailey some twelve years ago. Thrust a needle into the right costal interspace of the upper rim of the fourth rib, close to the sternal border, directing it upward. This measure can be accomplished "in the twinkling of an eye," and, should it fail, cardiac massage should be instituted at once. The head of the table should be lowered so that the force of gravity will assist the first efforts of the reviving heart. Some form of artificial respiration should also be instituted, the direct method of which consists of rhythmic pressure on the lower part of the thorax. If this is not effective, it should be discontinued after one minute, and Silvester's artificial respiration should be performed. Adequate respiration then should be maintained with an anesthesia machine by manual compression of the breathing bag. One hundred per cent oxygen should be used and the patient provided with a tight-fitting face mask. Further, an endotracheal tube should be inserted until the patient is again well oxygenated. If the patient's trouble seems to be chiefly respiratory, as in cases of "blue asphyxia," it is important to clear the airway, pull the tongue forward, administer oxygen, remove any impaction of the epiglottis and begin direct or indirect artificial respiration. (Caiger encountered this situation 6 times and relieved it by pulling the tongue forward and lifting the epiglottis with the finger.)

Becker commented that the occasional success of intracardiac injections is probably due to the stimulus of the needle prick, "since the injection of a drug into the heart or anywhere else is illogical in the absence of circulation." He agreed, however, that if there is no immediate response to massage, 2 cc. of a 2 per cent solution of procain hydrochloride or Lahey's ready-prepared combination of 0.5 cc. of epinephrine, 1:1,000, and 9.5 cc. of 1 per cent procaine hydrochloride should immediately be given. If the patient is old or physically debilitated, it is the practice of Lahey and his associates to inject only 5 cc. The injection should be made directly into the right auricle or ventricle.

In the presence of ventricular fibrillation, massage must be continued without delay. It has been demonstrated that after fifteen or twenty minutes of massage the blood flow is reduced by vasodilatation, causing a poor venous return. This effect may be counteracted by rapid injection of fluid into the arterial system, which will restore the circulating volume and also increase the irritability of the heart by the pressure within its chamber. It has been observed further that more blood may be diverted to the brain by placing a vessel clamp across the thoracic portion of the aorta, releasing it every half hour to protect the viability of the other tissues.

Cardiac massage *per se* will not only fail to correct fibrillation but may actually aggravate it. In that event, 5 per cent procaine hydrochloride applied to the surface of the fibrillating ventricle has been proved effective in augmenting the action of the

heart.

The electric shock treatment of cardiac arrest has increased in popularity in recent years. An alternating current (60 cycles) of 1 to 1.5 amperes is passed through the heart for less than a second. Repetition of the shock may be necessary. (In animals, 0.4 ampere for five seconds will cause fibrillation, whereas 0.8 ampere or more will stop it).

There are a number of apparatuses on the market for defibrillation. Most of them are cumbersome and expensive. Dr. Herbert Trace and I have devised a simple method of defibrillation by the use of two applicators properly wired and attached to a wall socket (Figs. 5, 6 and 7). The instruments and equipment are as follows: 1 metal tablespoon; 1 spatula (flexible metal table knife); 35 feet of electrical household wire, insulated and insulating tape. The procedure is as follows: 1. Split 3 feet of the wire and solder one end to the spoon and one end to the spatula. 2. Cover with tape, leaving the bowl of the spoon and 2 inches (5 cm.) of spatula exposed. 3. To the other end of the wire attach an electric plug. 4. Test the instrument by placing an unconnected light bulb on a table; insert the plug in the socket and touch the spoon to the end of the bulb and the spatula to the screw portion of the bulb. If the bulb lights up the instrument is in working order. The use of the instrument for defibrillation is as follows: 1. Place the spoon under the heart, on the posterior surface of the ventricle. 2. Place the spatula on the anterior surface of the ventricle. 3. Make sure there is no metalic contact with other instruments (retractors, artery forceps, etc.), thus avoiding a short circuit. 4. Direct assistant to insert the plug in the wall socket and remove it quickly—in and out in about three-fourths of a second (a 60-cycle alternating current of 1 to 1.5 amperes passes through the heart). 5. Repeat as indicated by the circumstances in the individual case.

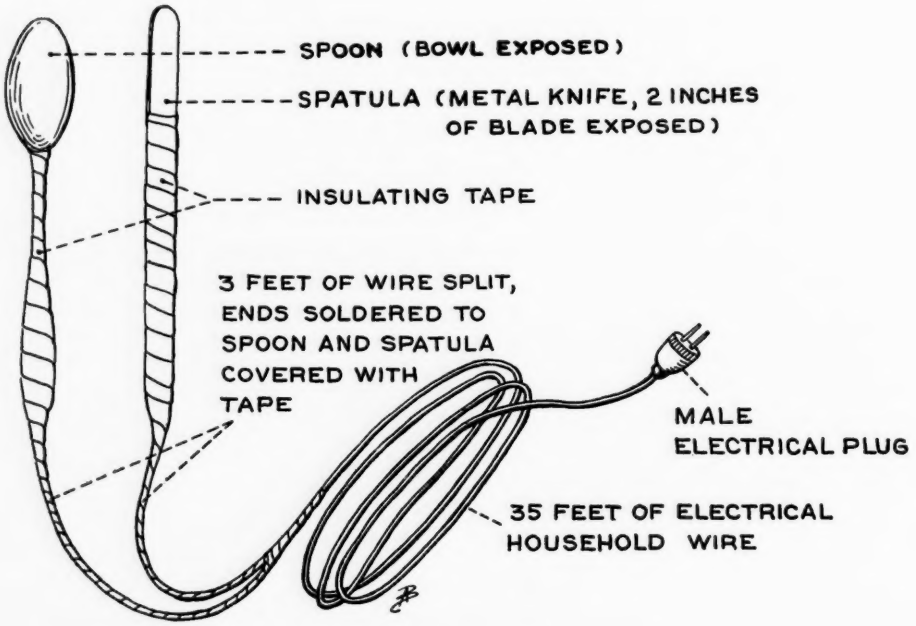
SPOON (BOWL EXPOSED)
SPATULA (METAL KNIFE, 2 INCHES OF BLADE EXPOSED)
INSULATING TAPE
3 FEET OF WIRE SPLIT, ENDS SOLDERED TO SPOON AND SPATULA COVERED WITH TAPE
MALE ELECTRICAL PLUG
35 FEET OF ELECTRICAL HOUSEHOLD WIRE

Fig. 5 (see text).

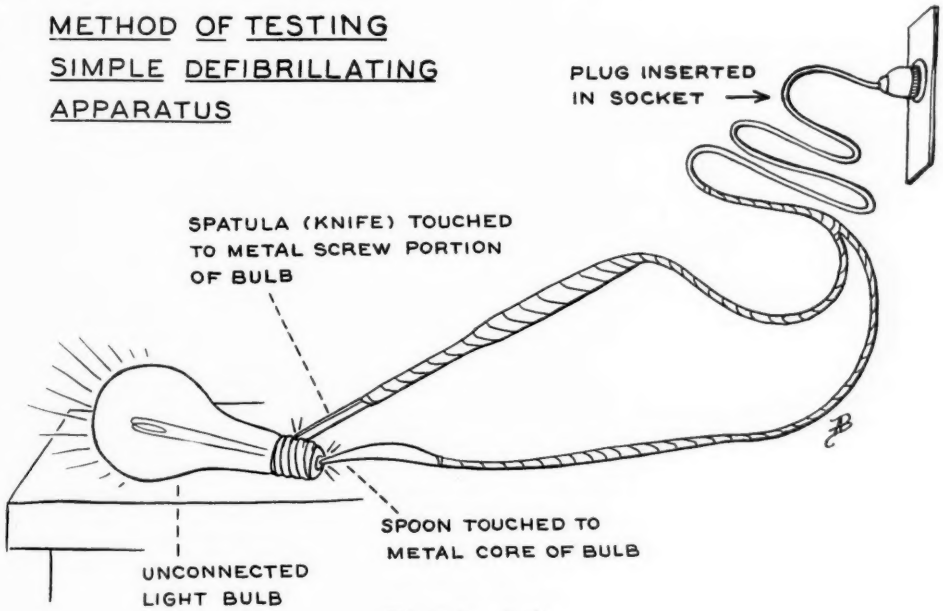

Fig. 6 (see text).

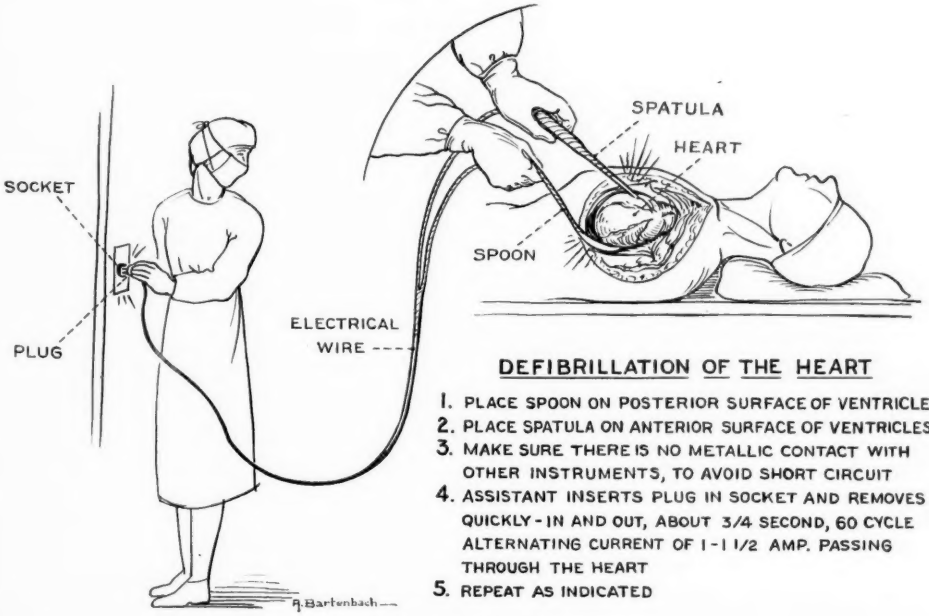
SOCKET
PLUG
ELECTRICAL
WIRE
SPATULA
HEART
SPOON
DEFIBRILLATION OF THE HEART
1. PLACE SPOON ON POSTERIOR SURFACE OF VENTRICLES
2. PLACE SPATULA ON ANTERIOR SURFACE OF VENTRICLES
3. MAKE SURE THERE IS NO METALLIC CONTACT WITH OTHER INSTRUMENTS, TO AVOID SHORT CIRCUIT
4. ASSISTANT INSERTS PLUG IN SOCKET AND REMOVES QUICKLY - IN AND OUT, ABOUT 3/4 SECOND, 60 CYCLE ALTERNATING CURRENT OF 1 - 1 1/2 AMP. PASSING THROUGH THE HEART
5. REPEAT AS INDICATED

Fig. 7 (see text).

In 1952, Zoll reported successful stimulation of the heart in 2 patients with complete heart block and cardiac arrest due to ventricular standstill. External electric stimulation by means of subcutaneous needle electrodes restored effective ventricular contractions. In 1 patient the heart was kept beating continuously by the artificial pacemaker for fifty-two hours of ventricular standstill.

Still another method of resuscitation of the arrested heart has been reported from Italy; intracarotid blood transfusion directed toward the brain, the common carotid artery being used. The purpose of this method is to supply the brain with blood more rapidly than is possible with intra-arterial blood transfusion directed toward the heart, thus reducing the hazards of dilatation and anoxia with permanent injury to the brain.

Automatic artificial respiration is most effectively achieved by means of the intratracheal tube. Another possibility is the use of a modern anesthetic machine to supply a high percentage of oxygen.

Hamilton Bailey has said, "A patient who inspires vomitus always dies; not necessarily at that time, but later, from bronchial pneumonia." If vomitus is inspired, promptly tilt the whole table to make use of the force of gravity; aspirate the material directly from the pharynx through the laryngoscope, and, when indicated, aspirate through a laryngotomy or do a tracheotomy.

By the procedures just described, "blue asphyxia" may be overcome in most instances. In cases of "white asphyxia" the difficulty is truly cardiac in origin and consequently far more dangerous. Cardiac massage should be undertaken at once.

The standard method of cardiac massage involves opening the abdomen to the midline from the xiphisternum. With the heel of the left hand pressing downward from the outside, the balls of the fingers of the right hand can exert effective pressure on the ventricles through the diaphragm. Nicholson's method differs from the standard method chiefly in the "buttonhole incision" which is made at once in the diaphragm behind the xiphisternum. That unforeseen complications may develop in massage of the heart was dramatically demonstrated in a case of rupture of the heart during this maneuver (Hurwitt and Seidenberg).

Collapse of the patient under intravenous anesthesia requires an antidote. This can be supplied by intravenous injection of a solution of picrotoxin 1:1,000 (1 mg. of picrotoxin acts as an antidote for 30 to 40 mg. of pentothal). The table should be instantly changed to the steep Trendelenberg position, and drugs that raise the blood pressure (e. g., methedrine) administered without delay. The blood pressure should be carefully watched throughout the remainder of the procedure and a constant saline drip maintained, with immediate increase of the flow should the pressure drop. It is notable that in comparatively few of the most recently reported cases of cardiac arrest did the emergency occur during spinal anesthesia. Of Best's 3 patients, the only one who recovered had had this form of anesthesia, Wolff's patient was undergoing thoracoplasty under spinal anesthesia, but suffered cardiac arrest just as the fourth cervical segment was being blocked. Prompt institution of cardiac massage and controlled respiration with oxygen restored the heart action within a few seconds, and later the thoracoplasty was done successfully with the patient under general anesthesia. It was thought possible that some trauma to the nerves of the pericardium might have taken place during the spinal injections, but direct proof was lacking. It is certain, however, that the innervation of the heart and pericardium is of the utmost importance in such a sequence. The pericardial nerves include fibers from the phrenic nerve—especially the left one—and also probably from the cardiac plexus.

Cardiac arrest in the case of Touroff and Adelman was explained as probably a vagovagal reflex arising from active manipulation of the left pulmonary hilus (during removal of a fibrosarcoma from

the left main bronchus) and from irritation of the bronchial mucosa by intrabronchial hemorrhage.

It is not at all unlikely that the opening of the pericardium in my case similarly initiated cardiac function through reflex stimulation.

Prognosis.—The cause of cardiac asystole has much to do with the prognosis.

When a normal heart has received an overdose of anesthetic, the outlook is good. If it has been suddenly arrested because of reflex phenomena (vagovagal reflexes), it will usually start beating again rather easily and if the time of arrest does not exceed three minutes the prognosis is good. If it has stopped because anoxia has induced asystole or ventricular fibrillation, there is danger that the brain was damaged before cardiac action ceased, which makes the prognosis much graver.

According to Goran Haglund, the length of time for which artificial circulation must be kept up before the heart pump regains normal, spontaneous action seems to have no major influence.

In 1 fatal case the interval was but seven minutes. In another, in which the starting interval was less than one minute, artificial circulation had to be kept up for seventy minutes, but the patient eventually made a complete physical and mental recovery. Haglund's opinion, however, is that the length of time the patient is in coma has prognostic significance.

Becker stated that prognosis depends on the length of time elapsed before massage, whether the heart is in standstill or in ventricular fibrillation; the degree of glycogen reserve and hypoxia; the presence or absence of noxious drugs or hormones; and the degree of diastolic filling and coronary blood pressure produced by massage. It is much more difficult to cause resumption of a normal beat from ventricular fibrillation than from cardiac standstill, and the ultimate prognosis, of course, depends mainly upon the duration of inadequate circulation of oxygenated blood.

SUMMARY

In the past ten years, 11 cases of cardiac arrest have been observed at the American Hospital of Chicago. Five of these were in the practice of Dr. Philip Thorek and 6 in the author's service. Six of the patients were saved by cardiac massage, and 5 died.

A review of the history and the literature of cardiac arrest and its treatment is presented. The etiology, incidence, diagnosis, treatment and prognosis are discussed.

A case of complete cardiac standstill lasting nineteen minutes is reported, and a simplified method of defibrillation has been suggested. The biochemical aspects of cerebral damage due to anoxia are discussed, and the possibility of reversing brain changes is illustrated by several cases cited from the recent literature. Though most authors agree that arrest lasting more than four minutes will do irreparable injury to the higher centers, several instances of complete recovery after much longer intervals are cited, and the conclusions of those making the reports are discussed.

Supply of oxygen to the brain and restoration of the heartbeat are the essentials to success. For this a good heart, normal lungs and adequate blood volume are a *sine qua non.* When there is severe cardiovascular disease or marked pulmonary fibrosis and inadequate blood replacement, the prognosis is grave.

ZUSAMMENFASSUNG

Es wird ein Überblick über die Geschichte und das Schrifttum des Herzstillstandes und seiner Behandlung vorgelegt. Die Ätiologie, Häufikeit, Diagnose, Behandlung und Prognose werden erörtert.

Während der letzten zehn Jahre kamen im American Hospital of Chicago elf Fälle von Herzstillstand zur Beobachtung. Davon stammen fünf aus der Praxis von Dr. Philip Thorek und sechs aus dem Krankengut des Verfassers. Sechs Kranke wurden

durch Herzmassage gerettet, günf starben.

Es wird über einen neunzehn Minuten lang bestehenden vollständigen Herzstillstand berichtet und eine einfache Methode der Defibrillierung vorgeschlagen. Die biochemischen Faktoren, die bei der durch Sauerstoffarmut entstandenen Gehirnschädigung eine Rolle spielen, werden erörtert. Die Möglichkeit, Hirnveränderungen zur Norm zurückzubringen, wird an Hand einiger im neueren Schrifttum berichteten Fälle erläutert. Wenn auch die meisten Autoren darin übereinstimmen, dass ein länger als vier Minuten anhaltender Herzstillstand die höheren Zentren endgültig schädigt, so lassen sich doch einige Fälle völliger Wiederherstellung nach erheblich länger dauernden Unterbrechungen anführen. Die von den verschiedenen Autoren solcher Berichte gezogenen Schlussfolgerungen werden erörtert.

Der Erfolg hängt im Wesentlichen von der Sauerstoffzufuhr zum Gehirn und von der Wiederherstellung des Herzschlages ab. Um dies zu erreichen, ist das Bestehen eines guten Herzens, normaler Lungen und einer ausreichenden Blutmenge eine conditio sine qua non. Wenn eine schwere Herzgefässerkrankung oder eine erhebliche Lungenfibrose vorliegt oder der Blutersatz unzureichend ist, wird die Prognose ernst.

RESUMEN

Se presenta una revisión de la historia y la literatura del paro cardíaco y su tratamiento. Se discute su etiología, incidencia, diagnóstico, tratamiento y pronóstico.

En los ultimos diez años, se han observado 11 caso de paro cardíaco en el Hospital Americano de Chicago. Cinco de ellos en el servicio del Dr. Philip Thorek y 6 en el servicio del autor. Seis de los pacientes fueron salvados por el masaje, habiendo muerto 5.

Se comunica un caso de paro cardíaco completo de diescinueve minutos de duración y se ejemplifica un método que se sugiere para desfibrilar. Se discuten los aspectos bioquímicos de la lesión cerebral debida a la anoxia, ilustrándose la reversibilidad de cambios vertebrales en casos citados en la literatura reciente. Aun cuando los autores estan de acuerdo en que el paro cardíaco de más de cuatro minutos produce una lesión irreparable de los centros superiores, se citan varios casos de recuperación completa después de un intervalo mayor de tiempo. Se discuten las conclusiones de los autores de las comunicaciones.

El aporte de oxígeno al cerebro y la restauración del latido Cardíaco son esenciales para el éxito. Para esto se requiere indispensablemente un buen corazón, pulmones normales y vol umen sanguíneo adecuado. Cuando existe padecimiento cardiopulmonar grave ó fibrosis pulmonary acentuada y remplazamiento sanguíneo inadecuado el pronóstico es grave.

RESUMO

Uma revisão da história e da literatura sôbre a parada cardíaca e seu tratamento é apresentada. A etiologia, incidência, diagnóstico, tratamento e prognóstico são discutidos.

Nos últimos dez anos, 11 casos de parada cardíaca foram observados no American Hospital de Chicago. Seis dêstes pacientes foram salvos pela massagem cardíaca, e 5 faleceram.

Um caso de parada cardíaca completa com duração de 19 minutos é apresentado, e um método simplificado da desfibrilação é sugerido. Os aspectos bioquímicos da lesão cerebral devido a anoxia são discutidos e, a possibilidade de recuperar as alterações cerebrais é ilustrada por diversos caso citados na literatura recente. Embora a maioria dos autores concorde que a parada com duração superior a 4 minutos lesa irreparàvelmente os centros mais elevados, diversos casos de restabelecimento completo após intervalo muito maior são citados, e as conclusões daquêles que fazem as comunicações são discutidas.

O fornecimento de oxigênio ao cérebro e a restauração do batimento cardíaco são essenciais ao sucesso. Para isto um bom coração, pulmões normais e volume sanguíneo adequado constituem uma condição

sine qua non. Quando há afecção cardiovascular grave ou fibrose pulmonar acentuada e substituição inadequada de sangue, o prognóstico é grave.

RIASSUNTO

Viene fatta la storia e raccolta la letteratura dell'arresto cardiaco e della sua etiologia, frequenza, diagnosi, prognosi e cura. Negli ultimi 10 anni l'autore ne ha raccolto 11 casi dall'American Hospital di Chicago (6 personali e 5 del dr. Ph. Thorek); ne furono salvati 6 col massaggio cardiaco e 5 morirono. In un caso l'arresto si protrasse per 19 minuti. Vengono studiati gli aspetti biologici delle lesioni cerebrali da anossia e la possibilità di rimediare ad esse. Benchè si creda che dopo i 4 minuti le lesioni dei centri nervosi divengano irreversibili, sono noti casi in cui si ottenne la guarigione completa dopo un intervallo anche assai più lungo. I fattori del successo sono rappresentati dal rifornimento di ossigeno e dalla ripresa del ritmo cardiaco; condizione indispensabile è la normalità del cuore, dei polmoni e del volume sanguigno. In presenza di gravi malattie cardiovascolari o polmonari la prognosi è infausta.

The man who threatens the world is always ridiculous; for the world can easily go on without him, and in a short time will cease to miss him.

Money and time are the heaviest burdens of life, and the unhappiest of all mortals are those who have more of either than they know how to use.

We love to overlook the boundaries which we do not wish to pass.

Nothing was ever said with uncommon felicity but by the co-operation of chance; and therefore wit, as well as valor, must be content to share its honors with fortune.

Differing from a man in doctrine is no reason why you should pull his house about his ears.

Self-love is often rather arrogant than blind; it does not hide our faults from ourselves, but persuades us that they escape the notice of others.

—*Johnson*

Varying Relations of the Common Bile Duct with the Posterior Face of the Pancreatic Head in Negroes and White Persons

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THE literature indicates that there is no complete agreement as to the denomination and extension of the various segments dividing the ductus choledochus (common bile duct). All authors, however, agree in mentioning a portion related to the head of the pancreas, naming it retropancreatic, intrapancreatic, transpancreatic or simply pancreatic.

The intimate anatomic connections of the common duct with the posterior face of the pancreatic head are of great practical value. Authors have described the reciprocal relations of the biliary tract with the gland starting with the simplest type, in which the duct was found juxtaposed to its surface, only in contact with it and covered by loose connective tissue and by the duodenopancreatic coalescence blade, up to the most complicated type, in which there was a canal completely closed by pancreatic tissue. Concerning its constitution there is no perfect agreement; nevertheless it is of great significance from a surgical point of view. As a matter of fact, the first authors who dealt with the subject believed in the existence of a pancreatic tissue tunnel through which the choledochus canal would pass. Later researches brought about new observations and showed that in fact there was no tunnel but a glandular laminar extension of the pancreatic head, of varying thickness and size. It covered, partially or totally, the pancreatic segment of the common duct, the free border of which appeared adherent to the upper and posterior part of the head of the pancreas, leaving, however, a plane of cleavage (filled with connective tissue) that gave access to the biliary tract. Further interest was aroused by this fact concerning the elongation of the pancreatic head of varying length and height, on which excellent studies have been made by local and foreign researchers, and which, in 1898, was compared to a "languette" by Letulle and Nathan-Larrier.

The purpose of this work, which was directed by Prof. Odorico Machado de Sousa, is to describe the pancreatic "lingula" in Negroes and white persons of both sexes, in relation to its frequency and manner of appearance in the Brazilian environment.

Review of the Literature.—The bibliographic research was greatly facilitated by the list of works mentioned by Degni (1945). Other authors who carried out anatomic researches on the choledochus-pancreatic relation were also included.

Wyss (1866) mentioned two groups of researchers who referred to the relations of the common duct with the pancreas. In the first group were Krause, Werber and Luschka, who admitted that the common duct, before by-passing the duodenal wall, went through the head of the pancreas. In the second were Meyer, Hirtl, Durzy and Henle, who made no reference to this

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matter. In 22 cases the common duct crossed the pancreatic head.

Helly (1898) observed approximately 70 cases, 40 of which were described in detail. Precise measurements were made. The common duct was always related to the pancreas over 2 to 7 cm. Five different types were distinguished:

1. The common duct was observed in a superficial groove in the pancreatic head, with which it was connected by dense connective tissue; the groove was 3 to 5 cm. long (9 cases).

2. The common duct was observed in a groove lateral to the pancreatic head, transformed into a canal by duodenopancreatic connections. The groove was 0.5 cm. long (6 cases).

3. The common duct was initially observed in a groove in the pancreatic head which farther along closed itself into a canal by the superposition of slender pancreatic lobules. The groove had an extension of 0.5 to 2.5 cm. and the canal one of 1.5 cm. (11 cases).

4. The common duct at first was observed in a groove and thereafter in a canal in the head of the pancreas which again became a groove. The groove was 0.5 to 2.5 cm. long in the first and 1 to 3 cm. long in the second portion, and the canal measured 0.5 to 2.5 cm. (7 cases).

5. The entire terminal segment of the common duct was observed in the canal of the pancreatic head, at variable depths and with lengths of 2 to 4 cm. (7 cases).

To the remaining cases the author made no special reference, mentioning that the statistics presented should not be considered an exact expression of the frequency of the different types. He did, however, show the intimate relation between the biliary tract and the pancreas. He also stressed the fact that, as a rule, the common duct entered into contact with the pancreas, though when point of confluence of the common cystic duct and the hepatic duct was caudal, the two ducts could meet in the pancreatic region.

Letulle and Nathan-Larrier (1898) studied the relations of the common duct with the pancreas in 19 of the 21 dissections. In 8 cases the common duct was lodged in the pancreatic head. In a majority of cases a simple small "lingula" or some pancreatic lobules were observed between the duodenum and the common duct, at maximum depths of 2 to 3 cm. In 11 cases the duct was loosely fixed by its anterior face to the duodenum and, more firmly, by its posterior face to the head of the pancreas. Measurements were made of the common duct, which confirmed the authors' impression that it gradually reduced itself as it neared the duodenal wall.

Wiart (1899) stated that, as a rule, the pancreatic groove existed where the common duct was lodged, the distal portion of which was deepened. The internal lip of the groove could almost cover completely the posterior face of the duct, so that it would seem intrapancreatic. The internal lip was removed by a probe and the common duct uncovered without cutting the glandular tissue. Of 10 cases, Wiart observed 3 in which distal portion of the common duct in its distal was included in a real pancreatic tunnel. The duct adhered lightly to the grooved walls and was easily freed. This portion of the common duct was called "retropancreatic," and the segment included in the thickness of the wall of the second portion of the duodenum was called "parietoduodenal".

Büngner (1903) examined 58 adult cadavers whose ages at death ranged from 23 to 81 years; 52 were male and 6 female. In 55 cases the common duct crossed the pancreatic substance obliquely to an extent of 2 cm. (maximum 4 to 5 cm. and minimum 8 mm.), and in 3 cases it passed laterally to the pancreatic head (twice "duodenally" and once dorsally).

The segment of the duct within the pancreas was covered in half of its course by a layer of pancreatic tissue 0.5 cm. thick on the average (maximum 2 cm. and minimum 2 mm.), and so firmly enclosed that it could not be dissected with the aid of blunt instruments.

The author stated that in 95 per cent of the cases the common duct, before en-

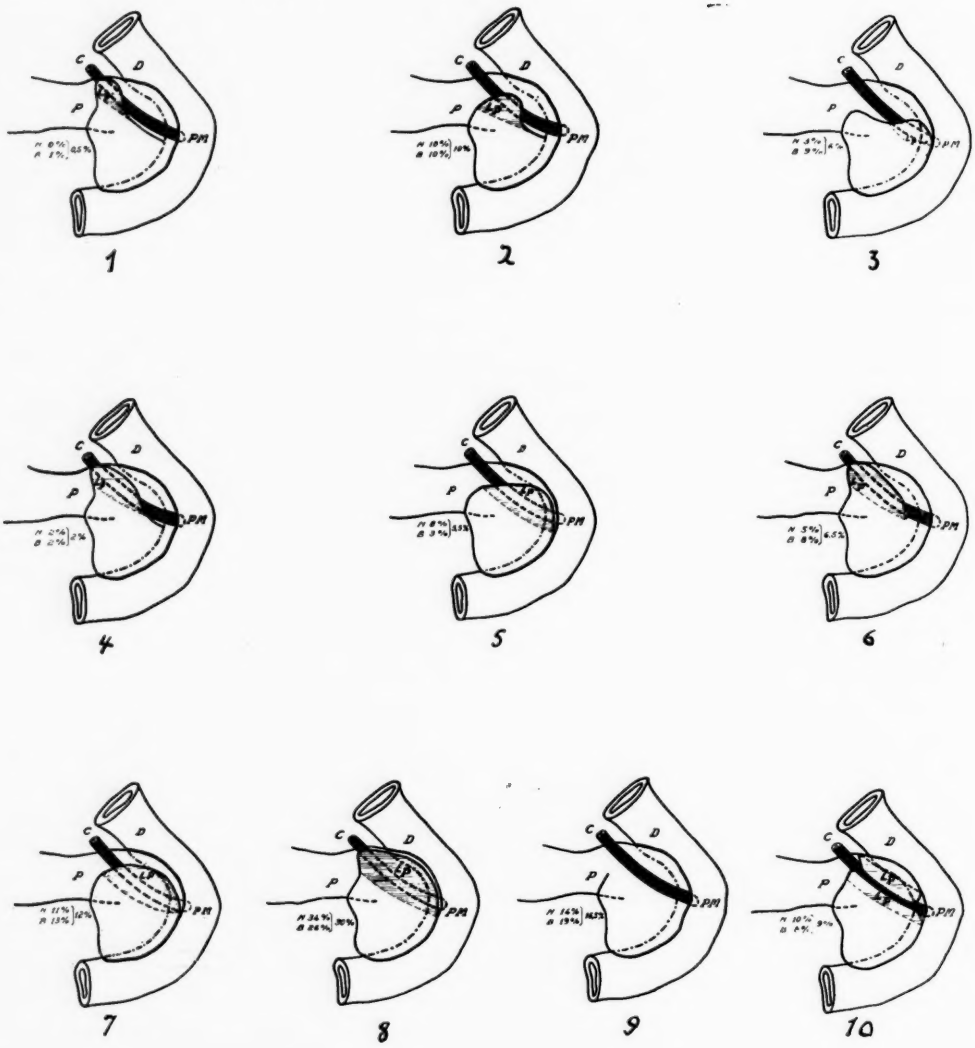

Fig. 1.—Diagrams of the dorsal face of the duodenum and of the pancreas head showing the "lingula" (*LP*). The number corresponds to the percentages in Negroes (*N*) and white subjects, (*B*). *PM*, major duodenal papilla; *D*, duodenum; *C*, choledochus and *P*, pancreas. *1*, "lingula" covering the proximal third of the choledochus in its pancreatic portion. (Group 1, subgroup 1). *2*, "lingula" covering the medium third of the choledochus in its pancreatic portion (Group 1, subgroup 2). *3*, "lingula" covering the distal third of the choledochus in its pancreatic portion (Group 1, subgroup 3). *4*, "lingula" covering the proximal half of the choledochus in its pancreatic portion (Group 1, subgroup 4). *5*, "lingula" covering the distal half of the choledochus in its pancreatic portion (Group 1, subgroup 5). *6*, "lingula" covering the proximal two-thirds of the choledochus in its pancreatic portion (Group 1, subgroup 6). *7*, "lingula" covering the distal two-thirds of the choledochus in its pancreatic portion (Group 1, subgroup 7). *8*, "lingula" covering the whole pancreatic portion of the choledochus (Group 2). *9*, tract of the choledochus in its pancreatic portion. Absence of the "lingula" (Group 3). *10*, two "lingulae," the upper with a cranial base and the lower with a caudal base (Group 4).

tering the duodenum, crossed the pancreatic substance and that in 5 per cent it passed laterally to the head of the gland.

Padula (1903), describing the course of the common duct, stated that it was placed between the duodenum and the head of the pancreas until it encountered the pancreatic duct, which it accompanied for a few millimeters.

Frequently the common duct, instead of running between the duodenum and the pancreatic head, dug into the latter a real groove. In other instances the biliary tract traversed the canal of that organ.

This author, who examined 165 cases, presented a diagram showing a section of the common duct and the three types of relations in the passage between the pancreas and the duodenum. No reference was made to the frequency of the 3 types.

Robinson (1907) presented 42 observations. The common duct was enclosed in the pancreatic tissue for a distance of ¾ inch (0.6 cm.). In 90 per cent of the cases it crossed the head of the pancreas obliquely, and was surrounded by pancreatic tissue, which rendered difficult its freeing by blunt dissection.

Ruge (1908) based his studies on 43 specimens. The common duct was observed twice on the posterior face of the pancreas; 4 times in a superficial groove of this face; 5 times in a deep groove difficult of dissection, and 32 times in complete pancreatic tissue. The difficulty of access to this portion of the common duct, owing to the anatomic dispositions mentioned and to the problem of hemostasis, as well as the danger of injuring the pancreatic duct, was stressed.

Baldwin (1911) described the relations of the common duct with the pancreas, stating that the former always ran caudally to the second portion of the duodenum and dorsally to the head of the pancreas, remaining in a very superficial furrow. The duct, to an extent of 0.5 to 5 cm., was completely surrounded by pancreatic tissue in 80 per cent of the cases. It was partially coated but not completely encircled by glandular tissue in 5 per cent of the cases, and in the remaining 15 per cent the biliary duct was observed in a furrow but not covered by pancreatic tissue. (No reference was made to the number of dissections.)

Belou (1915) studied 35 cases. The common duct in 14 cases (40 per cent) was in a furrow or sulcus, and in 12 cases (34 per cent) in an incomplete tunnel, which was thicker in the portion next to the parietal segment than in the portion adjoining the retroduodenal segment. In the upper part there was a furrow or sulcus, and in the lower part the duct became intrapancreatic. In 2 cases it seemed to be a complete tunnel. Touching the pancreatic tissue with a probe, however, sufficed to open the lips of the glandular groove which, behind the duct, can easily be separated. There was a complete tunnel in 9 cases (26 per cent). The pancreatic tissue behind the duct was thicker in the portion next to the intraparietal segment than in that next to the retroduodenum.

Maeda (1924) based his study on 60 cases. In only 1 instance was the retropancreatic common duct observed without a covering of pancreatic tissue.

Cameron (1924) studied 100 specimens with regard to the relations of the common duct with the pancreas. The common bile duct was within the pancreas head, surrounded by pancreatic tissue, in 69 per cent of the cases. In 31 per cent it was situated on the posterior surface of the gland in a fibrous furrow penetrating into the pancreas only in its terminal portion. Cameron's observations were compared with those of other investigators.

Fuchs, (1926) examined 50 adult cadavers by simple dissection and frozen cuts. He considered 4 main types and subordinated to these the forms of transition.

1. The common duct was observed to be oblique, with a slightly S-shaped course, in a shallow furrow directly attached to the pancreatic substance. This disposition was found in approximately one-fourth of the cases.

2. A layer of pancreatic tissue 3 to 5 mm. thick, covered the dorsal face of the common duct up to the posterior wall of the duodenum.

3. The variations of the previous type were considered under a separate group. For example, cases were found in which the common duct was entirely covered except in a small juxtaduodenal portion. In other cases a real groove was formed, covering half or three-quarters of the circumference of the duct.

Cases in which the complete canal was formed by the two lips of glandular substance united on the dorsal face of the common duct cut by loose conjunctive tissue, were described as variations.

4. This group included the cases in which the biliary tract perforated, axially, the pancreas head, surrounded on all sides by a layer of parenchyma 1 cm. thick. No cleavage plane was discovered in these cases.

Yamaguchi (1930) examined 140 cases, with the following results:

1. The pancreatic portion of the common duct was surrounded by the pancreatic substance in 120 cases. Two subgroups were established:

a. The entire pancreatic portion of the duct was surrounded (68 cases).

b. The greater part or only a small extension showed the involvement (53 cases). In these the distal end was more frequently covered, and was sometimes the medium or proximal one.

2. The internal half of the posterior face of the common duct or merely the internal border of this face was covered in 18 instances.

3. In 2 cases the posterior face of the common duct was totally uncovered.

Nuboer (1931), describing the extrahepatic portion of the biliary tract, pointed out that the common duct in its medium part was intimately connected with the pancreas. Of a total of 75 cases, the common duct was in a tunnel of pancreatic tissue in 50 cases (66.7 per cent). The part of the gland posterior to the duct was less thick than the anterior one. The duct was placed in a deep groove on the posterior face of the head of the pancreas in 20 cases (26.7 per cent). In these, nearly always, a small portion of the common duct, just above the duodenum, was completely covered by pancreatic tissue. In 2 cases (2.7 per cent) the duct was situated in a groove but covered on its posterior face by a small layer of pancreatic tissue. In 2 other cases (2.7 per cent) the duct was located in a groove on the anterior face of the pancreatic head. The duct was observed along the pancreas, with its terminal portion surrounded by the gland, in 1 case (1.3 per cent).

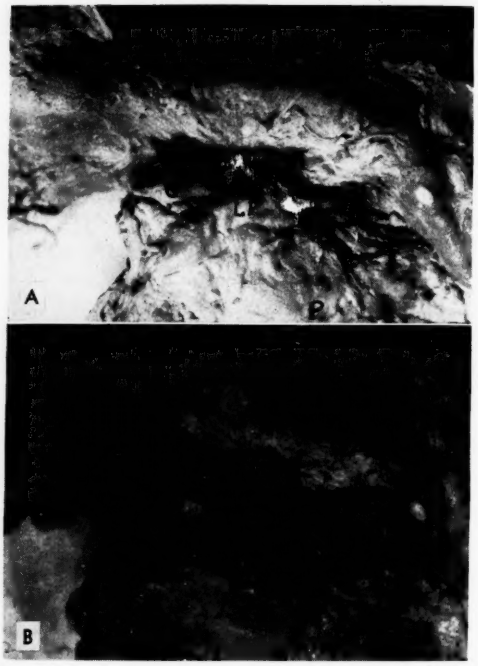

Fig. 2.—*A*, posterior view of the duodenopancreas. (V. R., male, 54 years old, white, Italian). The choledochus is covered by the pancreatic "lingula" in its medial third. *B*, same specimen. The pancreatic "lingula" shows the pancreatic portion of the choledochus.

Chlyvitch and Kozintzev (1937), in 100 dissected pancreases, observed 47 instances of supposed glandular canal covering the retropancreatic common duct in

its entire extension or merely in its distal segment. The pancreatic groove that lodged the duct was in most cases posteriorly closed by lymphatic ganglia. Authors expressed the opinion that when the nature of the tissue posteriorly closing the pancreatic groove was unknown, the existence of the glandular canal should be admitted, and the frequency rates increased to approach those recorded by English or German authors. Concerning the cleavage plane, the presence of loose cellular tissue, showing on the posterior face of the pancreas the obliquity of the retropancreatic common duct, was admitted. It was more frequently related to the right border of the duct, rarely corresponding to the middle of the anterior face of the duct. It corresponded to the posterior face of the duct in 1 case. The cleavage plane sometimes presented resistant transverse bundles of connective tissue. These opposed the separation of the margins of the glandular canal. From the anatomic point of view there was no real canal in the distal portion of the common duct. So far as I know, these authors were the first to state that the choledochus duct was only apparently intrapancreatic.

Näätänen (1941), in a study of 100 cadavers, 49 female and 51 male, divided his results into 3 groups:

1. The common duct was observed in a slit on the dorsal surface of the pancreatic head, covered by connective tissue, in 53 per cent of the cases.

2. The common duct was observed on the dorsal surface of the pancreatic head, covered by a pancreatic "lingula," (34 per cent of the cases), with an extension of 5 to 50 mm. and a thickness of 2 to 5 mm. at most.

3. The common duct was close to the dorsal surface of the pancreas, in a tunnel of pancreatic tissue, in 12 per cent of the cases, the length of which ranged from 30 to 60 mm.

In 1 case the duct was observed on the ventral surface of the pancreatic head; this case was described in detail, and attention was called to its rarity.

Finocchietto (1942) analyzed 100 cases of dissection under surgical conditions. With reference to the relations between the choledochus duct and the pancreas head, the following results were obtained:

1. In a group of 11 cases the common duct presented its anterior face juxtaposed to a groove and its posterior face crossed by blood vessels and their branches in 5 cases. There was no pancreatic "lingula". The duct was entirely superficial, covered by the blade of Treitz and the pancreatic duodenal vessels, in 2 cases.

In 4 cases the duct elongated itself in a deep tunnel, its posterior face being covered by the blade of Treitz except in a small extension, where there was a delicate pancreatic "lingula" covering a small portion of the duct.

2. In a group of 15 cases, after removal of the Treitz' fascia, the choledochus remained invisible. In 3 cases the dissection showed that the duct ran in a very deep canal that gave the impression of a complete pancreatic tunnel. By placing the Béniqué probe through an opening of the retroduodenal segment of the duct and palpating it through the posterior face of the pancreas, the presence of a series of connective tracts and small vessels, passing in the form of a bridge over the duct, was verified. In order to isolate these it sufficed to withdraw the cellulovascular blade and separate the "lingulae".

In 7 dissections the choledochus appeared to be completely covered by glandular tissue; even after introduction of the Béniqué probe through the superduodenal orifice, no interstice could be seen. On the concave border of the second portion of the duodenum, 4 or 5 vascular duodenal-pancreatic branches passing from one organ to another were dissected and sectioned. By light manual pressure the posterior face of the pancreas head was opened, showing the common duct. The lips were united by loose cellular tissue and, in some cases by small vessels. The common duct was surrounded by a connective mesh rich in vessels. In the upper portion, the lips of the pan-

creatic furrow ended at the duodenal angle, where the superior duodenal pancreatic vessels crossed and generally a lymphatic ganglion was observed. In the lower portion the lips covered a superampullar portion of the common duct surrounded by dense connective tissue, numerous vessels and the opening of Wirsung's duct. The 5 remaining cases in this group were not described.

3. In a group of 74 cases the dissections showed an aspect termed "typical" by the author: after isolation of the duodenopancreas and separation of Treitz' blade a lymphatic choledochus ganglion was observed in the cephalic portion, and underneath it, the upper pancreatic-duodenal vessels. On separation and section of the upper pancreatic-duodenal trunks, it was possible to separate the "lingula" thus revealing a good portion of the common duct covered red by a layer of cellulovascular tissue. When pincers were placed along the posterior face of the duct and its branches were opened, the entire pancreatic duct, except a small portion of the superampullar (which remained covered, owing to condensation of the cellulovascular layer) was shown.

In only 5 of the total series of 100 cases was the pancreatic tissue detected at first glance, passing on a continuous bridge behind the posterior face of the duct. These were the 5 remaining cases of the second group.

To the anatomist, the author pointed out that the common duct ran along a depression of the posterior face in 11 per cent of the cases and along a canal in 89 per cent; to the surgeon, the fact that the canal could be easily transformed into a furrow by simple ligature and section of the pancreatic vessels between which the common duct is located, without section of the smaller portion of the gland. In 5 per cent it would have have been necessary to section the parenchyma only very slightly.

Leiva (1943) pointed out that the choledochus crossed the posterior face of the pancreatic head obliquely from top to bottom and from left to right, running through a canal or partial, tunnsel, or totally surrounded by glandular tissue. Of 100 observations, he observed a canal in 36, a tunnel in 56; a canal in the first half and a tunnel in the second half of the retropancreatic tract of the common duct in 8 cases.

Nogueira (1944) examined 31 fresh adult cadavers of different nationalities, mainly Brazilians, Negroes and mulattoes, observing that the pancreatic gland embraced the common duct in 26 of the 31 cases, by means of two "lingulae", of which the left was almost always more fully developed.

In 19 of these cases the approximation of the pancreatic "lingulae" was on the right border of the common duct, and practically only the left "lingula" covered the posterior face of the duct.

The approximation of the "lingulae" occurred on the posterior face of the common duct, being therefore covered by the two "lingulae", in 7 instances.

In 5 cases the common duct was observed along a simple furrow; that is, there were no "lingulae," and the duct was reached by section of Treitz' fascia; in 1 of these cases the furrow was observed along the lateral border of the pancreatic head next to the duodenum.

No case of a real canal was observed and no junction of the "lingulae" on the left border of the anterior face of the common duct was recorded.

The retropancreatic common duct, was not covered by pancreatic parenchyma in 16 per cent of the cases.

In the remaining cases (84 per cent) the pancreatic portion of the duct was enclosed in a groove of pancreatic tissue presenting a cleavage plane which, after the duodenal-pancreatic mobilization, exposed the common duct without injuring the glandular parenchyma.

Degni (1945) referring to the length of the pancreatic segment of the common duct, pointed out that for measuring purposes two portions were considered with reserve: the retropancre-

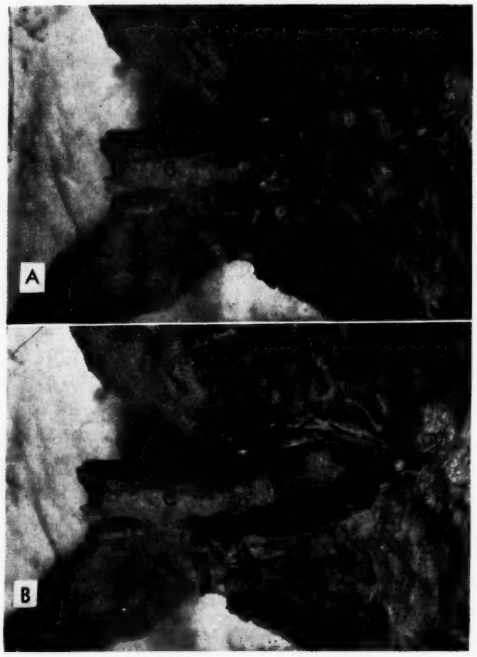

Fig. 3.—*A*, dorsal view of the duodenopancreas (J. D., a Brazilian Negro 85 years old). The choledochus and the small pancreatic "lingula" are seen covering the distal third. *B*, same specimen. The pancreatic "lingula" shows the entire pancreatic portion of the choledochus.

atic and the "intrapancreatic." As to the intrapancreatic variety, he admitted two possibilities resulting from the relations of the common duct, with the pancreatic "lingulae", namely, the complete and the incomplete tunnel. In the first instance the "lingulae" completely covered the choledochus duct from behind, with the exception of the blade corresponding to the cleavage plane. In the second instance the intrapancreatic segment of the duct was covered incompletely by the pancreatic "lingula". Another disposition was pointed out when the duct was between the duodenal margin of the pancreatic head and the duodenum (called interpancreatic-duodenal).

In Degni's work the following variations were observed in 55 cases:

1. There were 31 cases (86.4 per cent) in which the common duct was partly "intrapancreatic" and partly retropancreatic. In 10 cases (18.2 per cent) the duct was entirely intrapancreatic, forming an incomplete tunnel in 4 cases and a complete one in 6. In 7 cases (12.7 per cent) the duct was totally retropancreatic. In 4 cases (7.2 per cent) the duct was predominantly or totally interpancreatic-duodenal. In 2 cases (3.6 per cent) the duct was totally prepancreatic. In 1 case (1.8 per cent) the duct was retropancreatic (predominantly) and interpancreatic-duodenal.

With regard to the connections of the common duct (or the hepatic duct) with its pancreatic bed, the presence of the cleavage plane that allowed access to the biliary tract was studied. It was verified that this connection was loosened by connective tissue, which also joined the "lingulae" to each other or the "lingulae" to the pancreas behind the choledochus, thereby constituting the cleavage plane.

The duct was easily detachable from its bed, owing to the nature of the union. In addition to loose connective tissue, blood vessels were observed. In cases in which the common duct was totally or partially "intrapancreatic," a cleavage plane leading to that canal was always found. Therefore, it was always *apparently* intrapancreatic, since in all cases there was a connective septum indicating that the duct was not really intraglandular.

In reference to the small retrocholedochus pancreatic "lingulae," 75 cases were studied in detail, described and illustrated. The length of the common duct covered by eventual "lingulae" was noted. In 12 observations (16 per cent) there were 2 "lingulae," one with a left lateral caudal base and the other with a right lateral base, related to the common duct; the latter were always less well developed than the former, except in 1 case, in which the "lingula" of the right lateral base was the wider. In 10 observations (13.3 per cent) there was no "lingula," so that the common duct was retropancreatic or prepancreatic. In 53 observations there

was only 1 "lingula" with a left caudal lateral base (70.7 per cent). Therefore, in 65 of the 75 observations (86.6 per cent) one or two "lingulae" covered the pancreatic segment of the common duct, showing a supposed glandular canal. In 20 of these cases the thickness and length of the "lingula" were studied in detail.

Freitas (1948) examined 100 cadavers, 64 male (28 white and 36 Negro) and 36 female (10 white and 26 Negro) in order to study the duodenum and its relations with the neighboring organs. Referring to the common duct, he pointed out that: "The choledochus penetrates into the pancreas, has a variable course in all the intrapancreatic extension with a single opening into the duodenum. On all cases examined we observed that the choledochus always ends with the pancreatic canals at the right angle formed by the lower or distal extremity of the second portion of the duodenum with the proximate extremity of the third."

In a second research (1950), he included 40 other dissections made on 28 male cadavers (9 white and 19 Negro) and 12 female cadavers (5 white and 7 Negro), confirming his previous observations.

Sterling (1949) dissected 80 specimens, pointing out that the common biliary duct on crossing the pancreas frequently became narrowed.

In 16 of 49 cases (32.6 per cent) the extraduodenal distal portion of the common biliary duct was extrapancreatic. In 15 cases (30.6 per cent) the duct was totally intrapancreatic, and in the remaining 18 cases (36.8 per cent) it was partially intrapancreatic.

Bustos (1951) referred to studies made in 1933 on 54 cadavers, the originals of which I was unable to obtain. Bustos pointed out that the descriptions found in classic books should not be considered to represent the normal and or even the most common disposition.

The choledochus was observed in a pancreatic canal in 30 per cent of the cases; in 18 per cent the tunnel was very short, existing only close to the duodenal wall. In 9 per cent the choledochus ended very high, close to the first portion of the duodenum, or even in the first portion, touching tangentially the head of the pancreas. Therefore, in 45 per cent of the cases the most frequent disposition was that which could be termed duodenal interpancreatic, in which the common duct runs over the dihedrom angle formed by the head of the pancreas and the duodenum.

Taking all cases into consideration, 84 per cent did not show the common duct covered by pancreatic tissue.

The end point of the common duct in the duodenum, with or without the ampulla of Vater, was variable. In addition to its most common ending (in the second portion of the duodenum) the choledochus sometimes opened in the first or in the third portion, crossing the entire posterior face of the pancreas close to the surface or in a smooth canal, always covered by Treitz's blade.

Comment.—Initially I wish to stress the fact that the diversity in the frequency of types recorded by the different researchers was conditioned by various factors, mainly the variety of the methods of study, the difference in orientation of the observations and criteria of research, which in most cases were sufficiently described to serve as a basis or in comparison with later studies. The different numbers of observations, some being very small, studied by certain authors, may be seen by the following list, was also doubtless one reason for the conflicting results: (Wyss, 22 cases; Helly, 40; Letulle and Nathan Larrier, 19; Wiart, 10; Büngner, 58; Padula, 165; Robinson, 42; Ruge, 43; Baldwin, (?); Belou, 35; Maeda, 60; Cameron, 100; Fuchs, 50; Yamaguchi, 140; Nuboer, 75; Chlyvitch and Kozintzev, 100; Näätänen, 100; Finochietto, 100; Leiva, 100; Nogueira, 31; Degni, 75; Freitas, 140; Sterling, 80, and Bustos, 54).

On the other hand, the data are divided into two groups: (a) studies made care-

lessly, with no description of types or of variations in the "lingula" and no reference to the identification of the material, and (b) more detailed works classifying the different types of "lingulae" observed and reuniting them in distinct groups, some identifying the studied material.

There was no consistency as to the manner of grouping the pancreatic "lingulae" into types and subtypes in reference to the extent to which they covered the choledochus.

The majority did not even refer to "double lingula," one caudal and the other cranial. With few exceptions, the portion of the choledochus covered by the "lingulae" was not placed in an outstanding position. No consideration was given to the portion covered merely by lymphatic ganglia, arteries, veins and peritoneal coalescence blade. It was not mentioned which of the two portions was the larger, a point of practical interest. In this respect Degni's work stands out.

Concerning the anatomy textbooks, I forego a revision in this respect, since they summarily describe the relations of the choledochus with the pancreas in a neccessarily abritrary manner, not on the basis of proper researches in series.

From the foregoing comments it would seem, further, that a study of more abundant material of different ethnic values would be fitting.

Material of Present Study.—My material consisted of 200 autopsy specimens from the Department of Pathological Anatomy of the Medical School of the University of São Paulo, duly identified, 100 being white and 100 Negro, more or less pure in breed according to the essential somatoscopic characteristics (in Brazil, we are unable to speak of "pure" Negroes). Among the whites there were 75 male and 25 female subjects; 67 were Brazilian, 17 Italian, 5 Spanish, 4 Portuguese, 3 German, 2 Libanese, 1 Czechecoslovak and 1 Lithuanian. Among the Negro subjects there were 59 male and 41 female specimens; 99 were Brazilian and 1 South African. Adults predominated.

The specimens were collected in two ways: 1. I was present at the autopsy, and after the organs were examined I received those in which I was interested. These comprised the duodenum, the pancreas, part of the stomach, elements of the hepatic pedicle, the mesocolon and the mesenteric roots. The specimens were numbered and preserved in formaline solution of formaldehyde. 2. After the autopsy the specimens were studied by other researchers of the Department of Descriptive and Topographic Anatomy, whose studies were related to the stomach, liver or gastroduodenal pylorus. After they had been used for these researches they were numbered and preserved in solution of formaldehyde for this study.

I recorded the number and identity of

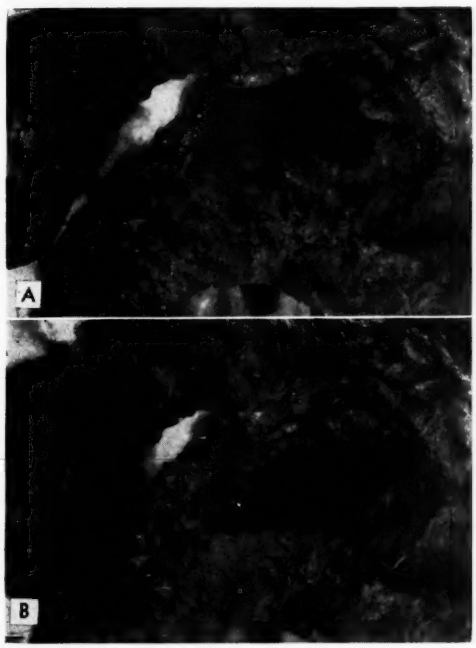

Fig. 4.—*A*, dorsal view of the duodenopancreas (C. R., a Brazilian Negro 54 years old). The choledochus is covered in its proximal half by the pancreatic "lingula." *B*, same specimen. The pancreatic "lingula" shows the entire pancreatic portion of the choledochus.

each specimen on a registry card.

Method.—The specimen, after it was fixed in solution of 10 per cent formaldehyde, was reduced, with retention of the pancreas, the duodenum, some centimeters of the gastric antrum, the choledochus and the cystic duct when the latter joined the biliary duct at a low level. The body and tail of the pancreas, as sectioned during the autopsy, were not included in some specimens. The preparations used in other previous studies had not included the pylorus and the gastric antrum.

A preestablished plan was followed, with the purpose of securing the maximum knowledge from the material by isolating and observing all the elements that served as a basis to this and other works.

The dissection was started at the posterior face of the head of the pancreas in order to identify the pancreatic "lingulae," in relation to the pancreatic segment of the choledochus. I isolated, when present, the arteries, the veins and the lymphatic ganglia, and freed the posterior surface of the pancreatic head from the coalescence peritoneal membrane, seeking the cleavage plane formed by the loose connective tissue that joins the free border of the pancreatic "lingula" to the posterior face of the cranial portion of the pancreatic head. The "lingula" was carefully dissected with fine scissors. Divulsion maneuvers were made through the loose connective tissue existing in this region until I reached the choledochus, which was not withdrawn from its bed. A diagram was made, recording the conformation of the "lingula" when it existed, showing the portion of the choledochus covered by it.

Results.—My observations were gathered in five groups in decreasing order of frequency, among which some presented subgroups, and to these I subordinated the forms of transition. I divided the material as follows

1. Presence or absence of the "lingula."
2. When the "lingula" existed whether it was single or "double" (2 "lingulae").
3. In both cases, whether it covered totally or partially the pancreatic portion of the choledochus.
4. In the latter instance, to what extension and level the choledochus was covered by the "lingula."

Finally, I considered a group that included all instances of less frequent morphologic aspects.

To understand the term "pancreatic lingulae" it is necessary to remember that I considered these present only when there was juxtaposition of their free borders with the remainder of the pancreatic head or when there was juxtaposition of the free borders of the two "lingulae," there existing always, of course, an interposed laminar connective septum. If direct juxtaposition was lacking and this space between the borders was filled with connective tissue, I considered it an instance of the choledochus located in the furrow of the posterior face of the pancreatic head.

The frequency of the different types of pancreatic "lingulae" in whites and Negroes of both sexes was verified. As the number of whites and Negroes was equal (100 each), the frequency of each type would also be the percentage for whites and Negroes.

The first group included the cases of unique pancreatic "lingula" of caudal base and variable extension, partially covering the choledochus. It was observed in 39 Negroes and 46 white subjects, making 42.5 per cent of the total.

This group was divided into seven subgroups according to the extension of the pancreatic portion of the choledochus covered by the "lingula."

1. The pancreatic "lingula" covered only the proximal third of the pancreatic portion of the choledochus. This was observed in a white subject.

2. The pancreatic "lingula" covered the medial third of the pancreatic portion of the common duct. This subgroup included

10 Negroes and 10 whites.

3. The pancreatic "lingula" covered merely the distal third of the pancreatic portion of the choledochus. This was found in 3 Negroes and 9 whites.

4. The pancreatic "lingula" covered the proximal half of the pancreatic portion of the choledochus. This ocurred in 2 whites.

5. The pancreatic "lingula" covered the distal half of the pancreatic portion of the choledochus. This was seen in 8 Negroes and 3 whites.

6. The pancreatic "lingula" covered the two proximal thirds of the pancreatic portion of the choledochus. This was found in 5 Negroes and 8 whites.

7. The pancreatic "lingula" covered the two distal thirds of the pancreatic portion of the choledochus. This was found in 11 Negro and 13 white specimens.

The second group comprises the cases of unique pancreatic "lingula" with a caudal base, covering the entire pancreatic portion of the choledochus. This was observed in 34 Negro and 26 white specimens, 30 per cent of the total.

The third group comprises the cases in which no pancreatic "lingula" was present. The pancreatic portion of the choledochus was merely juxtaposed to the posterior face of the head of the pancreas and was fixed thereto by means of a coalescent membrane with venous, arterial and lymphatic elements. This was observed in 13 Negro and 17 white specimens. In 1 Negro and 2 white specimens there was a slight trace of a groove. This group corresponded to 16.5 per cent of the total.

In the fourth group are included cases of double "lingula"; an upper one with a cranial base and a lower one with a caudal base, always juxtaposed by their free border. This was observed in 10 Negro and 8 white specimens, making 8 per cent of the total. This group was subdivided into two subgroups

1. The "lingulae" covered the pancreatic portion of the choledochus in all its extension in 4 Negro and 2 white specimens.

2. The "lingulae" partially covered the pancreatic portion of the choledochus and were of varying extent in 6 Negro and 6 white specimens.

The fifth group included less frequent morphologic variations. This was observed in 4 cases, 2 per cent of the total. In 2 Negro and 1 white specimen, in addition to dissecting the "lingula," it was necessary to section the pancreatic tissue to a small extent to obtain complete freedom of the choledochus.

Only by previous histologic examination, however, would it be possible to evaluate this tissue, in lieu of a real absence of the cleavage plane.

In 1 Negro specimen the choledochus presented was prepancreatic, lodged in a groove covered by conjunctive tissue and therefore dissectable through the anterior face of the head of the pancreas.

Sex Incidence: In relation to sex, my observations were as follows: The first group includes the single pancreatic "lingula" with a caudal base and variable extent, partially covering the choledochus. This was present in 56 male specimens (33 white and 23 Negro) and 29 female specimens (13 white and 16 Negro).

In the first subgroup there were no male specimens and only one female (white); in the second, 13 male specimens (6 white and 7 Negro) and 7 female specimens (4 white and 3 Negro); in the third, 6 male specimens (all Negro) and 6 female specimens (3 white and 3 Negro); in the fourth, 4 male specimens (2 white and 2 Negro) and no female specimens; in the fifth, 5 male specimens (1 white and 4 Negro) and 6 female specimens (2 white and 2 Negro); in the sixth, 9 male specimens (7 white and 2 Negro) and 4 female specimens (1 white and 3 Negro), and in the seventh, 19 male specimens (11 white and 8 Negro) and 5 female specimens (2 white and 3 Negro).

In the second group the unique "lingula" with a caudal base, totally cover-

ing the retropancreatic portion of the choledochus duct was present. There were 42 male specimens (21 white and 21 Negro) and 18 female specimens (5 white and 13 Negro).

In the third group the "lingula" was absent. There were 22 male specimens (15 white and 7 Negro) and 11 female specimens (4 white and 7 Negro).

In the fourth group the double "lingula" was present. There were 11 male specimens (5 white and 6 Negro) and 7 female specimens (3 white and 4 Negro).

In the fifth there were less frequent morphologic variations. There were 3 male specimens (1 white and 2 Negro) and 1 female specimen, Negro.

Results.—From an analysis of these observations it is verified that the pancreatic "lingula" is a very frequent anatomic formation, having occurred in 83 per cent of the cases.

The "lingula" had a variable development. All types of transition, from the slightest projection covering a small segment of the choledochus (42.5 per cent) to the most highly developed type, completely covering its retropancreatic portion (30 per cent), were observed.

These are the cases in which the choledochus is apparently intrapancreatic, as it is totally surrounded by glandular tissue. The isolation of the "lingula" is difficult, even on the fixed anatomic specimen, since its free border has a varied localization. It may coincide with the upper border of the head of the pancreas, therefore, far from the choledochus, and also because the "lingula" in these cases is thick. Some researchers considered this situation merely intrapancreatic.

In the greater number of types observed, constituting the first group, the "lingula" had a larger or smaller development, partially covering the pancreatic portion of the choledochus duct (42.5 per cent of the total). The "lingula" had varied extensions. For a better understanding, it was necessary to divide it into seven subgroups, into which the transition types were included.

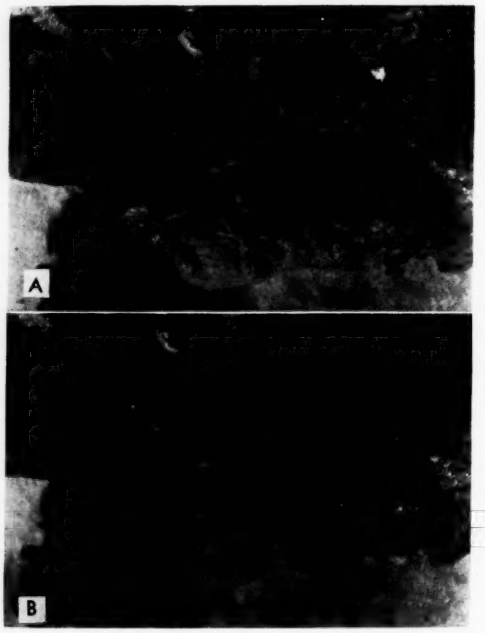

Fig. 5.—*A*, dorsal view of the duodenopancreas (F. M. C., a white Brazilian woman 55 years old). The pancreatic choledochus is seen in its proximal half; the distal half is covered by the pancreatic "lingula." *B*, same specimen. The pancreatic "lingula" shows the choledochus in its entire pancreatic portion.

Absence of the "lingula" was observed in 16.5 per cent of the cases. In these the choledochus was easily exposed, covered merely by lymphatic ganglia, arteries, veins and peritoneal coalescence membrane, which permitted its access without damaging the pancreatic tissue.

The fourth group included the cases of a double "lingula." The dissection of these was very easy, as the "lingulae" were slender and juxtaposed on the posterior face of the choledochus. This type was observed in 9 per cent.

In the fifth group were included less frequent morphologic variations, which were observed in 4 cases, or 2 per cent of the total. In 3 cases, in addition to the "lingula," there was a slender bridge of pancreatic tissue over the choledochus, which was sectioned to free it completely.

TABLE 1.—*Statistics on Negro Subjects*

Group	Male	%	Female	%	Total	
I	23	23	16	16	39	39%±4.96
II	21	21	13	13	34	34%±4.73
III	7	7	7	7	14	14%±3.46
IV	6	6	4	4	10	10%±3
V	2	2	1	0	3	3%±1.70

TABLE 2.—*Statistics on White Subjects*

Group	Male	%	Female	%	Total	
I	23	33	13	13	46	46%±4.98
II	21	21	5	5	26	26%±4.38
III	15	15	4	4	19	19%±3.92
IV	5	5	3	3	8	8±%2.71
V	1	1	0	0	1	1±%0.99

Macroscopically, the impression was that of continuity of the pancreatic tissue.

The choledochus in a prepancreatic position is rare. It was observed in only 1 case (0.5 per cent). The duct with its normal caliber reached the duodenum by the inferior face of the pancreas head lodged in a groove, covered only by loose connective tissue, blood vessels and peritoneal membrane. Owing to the special prepancreatic position of the choledochus, this observation was excluded from the general computation of data on the absence of the "lingula" which refer to the dorsal face of the head of the pancreas.

Cleavage Plane: The dissection plane between the free border of the "lingula" and the posterior face of the head of the pancreas, giving access to the retropancreatic portion of the choledochus duct, was observed in 100 per cent of the cases in which "lingula" were present.

Its identification presented difficulty only when the pancreatic "lingula" was unique and covered the entire retropancreatic choledochus, that is, in 30 per cent of the cases, in which the free border of the "lingula" sometimes was confused with the upper border of the pancreatic head. Aside from these cases, its discovery and the research on the specimens were very easy, especially when only the distal portion of the choledochus was covered. In the cases of double "lingulae" the borders of both, generally, juxtaposed themselves on the posterior face of the choledochus, and the simple maneuver of divulsion introduced by Degni sufficed to show the entire choledochus.

In 3 cases it was necessary to section a small extension of the pancreatic tissue so as to free the choledochus completely. The cleavage plane in all 3 cases was perfectly identified and the "lingula" freed. Glandular tissue was present; its continuity, in the process of dissection, was interrupted.

COMMENT

In order to compare these results with those of other authors, their cases were grouped according to the five types here presented. This was not always possible, either because of inaccurate description in some studies, or because of the fact that the authors did not record the five types.

With regard to the first group, which comprises the choledochus partially covered by the "lingula" and present in 42.5 per cent of the cases, Helly noted it in 45 per cent of his 40 observations, and Letulle and Nathan-Larrier in 42.1 per cent (8 of 19 observations). They did not describe in detail the extent of the covered duct. Wiart observed 30 per cent (3 cases of 10) in which the duct in its last centimeter was included in a real pancreatic tunnel. Büngner verified that, in 55 of 58 cases observed, the choledochus crossed a pancreatic substance (94.8 per cent). Padula admitted the existence of this type. Robinson referred to the fact that the choledochus was included in the pancreatic tissue in 90 per cent of the cases (he studied 42 cases). Belou noted an incomplete tunnel in 12 cases (34 per cent). Fuchs admitted the existence of this group, describing some of the subgroups considered here without, however, giving

the number of cases. Yamaguchi verified, in his 100 dissections, 34 cases (34 per cent) belonging to the first type. Finochietto observed 78 cases that could be included in the first group (78 per cent). According to Leiva, the "lingula" partially covered the duct in 8 per cent of cases. Some approximate those here presented, aside from a great difference in percentages, which probably can be attributed to diversity of opinion in observation.

In relation to my Type 2, in which the choledochus is totally covered by the unique pancreatic "lingula" with a caudal base, which was verified in my material in 30 per cent of the cases, Helly noted it in 17.5 per cent of his 40 cases. Belou observed a complete tunnel in 9 cases (26 per cent). Yamaguchi observed the entire retropancreatic portion to be covered in 68 cases (48.5 per cent). Nuboer referred to 50 cases (66.7 per cent). Näätänen recorded 12 cases of this type (12 per cent). Finochietto classified 10 cases (10 per cent) in this group. Leiva described the "lingula" as entirely covering the choledochus in 56 per cent of cases.

Some authors listed in a single group the cases that correspond to those in my first and second groups, giving the total results.

Chlyvitch and Kozintzev reported a supposed glandular canal surrounding the entire retropancreatic portion of the choledochus, or only its distal segment, in 57 cases (57 per cent). Nogueira observed the pancreatic "lingula" partially or totally covering the choledochus in 19 cases (64.2 per cent). The pancreatic "lingula" partially or totally covered the pancreatic portion of the choledochus in 53 cases (70.7 per cent), according to Degni. On addition of my results in the first and second groups, 30 per cent plus 42.5 per cent, I arrive at 72.5 per cent, a result corresponding to Degni's.

Type 3 includes the cases in which the choledochus was entirely retropancreatic, merely juxtaposed to the posterior wall of the head of the pancreas and affixed thereto by the peritoneal coalescene membrane with lymphatic, arterial and venous elements, which I observed in 16.5 per cent, Helly observed it in 37.5 per cent of his cases; Letulle and Nathan-Larrier in 57.8 per cent (11 of 19 cases). Büngner recorded 3 cases, or 5.1 per cent. Padula admitted the existence of this type. Belou verified a furrow or groove in 14 cases (40 per cent). Maeda mentioned only 1 case in 60 dissections (1.6 per cent). Yamaguchi proved the absence of the "lingula" in 2 cases (1.4 per cent). He considered as a separate group that in which the "lingula" covered only the internal half or the internal border of the duct, observed in 18 cases (12.8 per cent) which I included in my third group. Näätänen verified the absence of the "lingula" in 53 cases (53 per cent); Finochietto in 7 cases (7 per cent) and Leiva in 36 cases (36 per cent). Among the local authors, Nogueira verified the absence of the "lingula" in 5 cases (16.1 per cent) and Degni in 75 observations, 10 cases (13.3 per cent). My result, 9 per cent, corresponds to those of Finochietto and closely approximate those Nogueira and Degni.

It is worth mentioning that since there

TABLE 3.—*Incidence in Male Subjects*

Group	*Negro 59*		*White 75*		*Total 134*	
I	23	38.9%	33	44.0%	56	41.7%±5.90
II	21	35.5%	21	28.0%	42	31.3%±4.89
III	7	11.8%	15	20.0%	22	16.4%±3.79
IV	6	10.1%	5	6.6%	11	8.2%±2.77
V	2	3.3%	1	1.3%	3	2.2%±1.46

TABLE 4.—*Incidence in Female Subjects*

Group	*Negro 41*		*White 25*		*Total 66*	
I	16	39.0%	13	52%	29	43.9%±3.83
II	13	31.7%	5	20%	18	27.2%±3.99
III	7	17.0%	4	16%	11	16.6%±3.52
IV	4	9.7%	3	12%	7	10.6%±3.69
V	1	2.4%	0	0%	1	1.5%±1.20

is no uniform criterion for identifying the "lingula," its presence or absence depends a great deal upon the observer's personal way of considering it.

The fourth group has no outstanding position with the majority of researchers, and only Fuchs, among foreign authors has referred to it, considering it a subgroup. Helly, Letulle and Nathan-Larrier, Näätänen, Yamaguchi, Finochietto and others who described similar material in some detail did not record the presence of this variety. The same is not true of the local researchers. Nogueira observed 2 "lingulae" in 7 cases (22.5 per cent) and Degni in 12 cases (16 per cent). In my own material I observed 18 cases, totaling 9 per cent. As compared with those given by the aforementioned authors, the percentages are not in agreement.

Under Type 5 I collected the cases in which there were less frequent morphologic variations.

I observed the prepancreatic choledochus only once (0.5 per cent). Näätänen described 1 case out of 100 and Nuboer 2 cases (2.7 per cent). Chlyvitch and Kozintzev mentioned 1 case. Degni recorded 2 cases (3.6 per cent).

In this group I also included 3 cases (1.5 per cent) in which, besides the dissectable pancreatic "lingula," it was necessary to resect a small part of the pancreatic tissue in order to free the choledochus completely.

Finochietto claimed that it was necessary to section the pancreatic tissue to free the choledochus in 5 cases.

In order to facilitate comparative study on the frequency of the types of pancreatic "lingulae" in Negro and white persons, I presented tables of statistical percentages and corrections of the results previously referred to. It is to be noted that, in the total results of the group, there is no difference of any statistical value.

The variations in the frequency of types of pancreatic "lingulae" in both sexes enabled me to compile the following table,

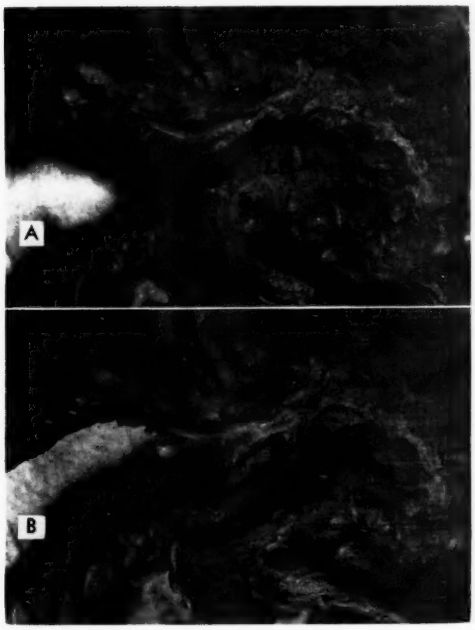

Fig. 6.—*A*, dorsal view of the duodenopancreas (A. J. C., a Brazilian white man 26 years old). The pancreatic portion of the choledochus is covered in its proximal two-thirds. *B*, same specimen. The pancreatic "lingula" shows the entire pancreatic portion of the choledochus.

in which it is apparent that the total values for the different groups are very close, there being no sufficient statistical difference to be significant.

In order to verify the statistical value of the differences in percentage of the various groups of pancreatic "lingula" in Negroes and white persons, and in both sexes, I proceeded to calculate the standard error in the difference of these percentages.*

For this comparison I merely considered Group 2, in which the percentage difference between Negroes and white persons was greater.

This difference (8) was 1.25 times greater than the standard error (6.4 per cent). It was therefore within the fluctua-

*Formula $E_{12} = \frac{}{V\ po.\ qo.\ (1/n_1 + 1/n_2)}$

tion limits of the sample and may be considered at random.

With regard to sex distribution, I also considered Group 2, in which the difference in percentages was greater. This difference (4.1 per cent) was 0.60 times smaller than the standard error (6.8 per cent). It was therefore within the fluctuation limits of the sample, and may be considered at random.

Dissection of the choledochus in its pancreatic portion presents no difficulty when there is no pancreatic "lingula," as the duct is juxtaposed to the posterior face of the head of pancreas or placed in a more or less deep furrow.

When there is a pancreatic "lingula," however, dissection is more difficult and arduous, requiring careful tactics and highly technical maneuvers. These were suggested, studied and described by Degni in his thesis.

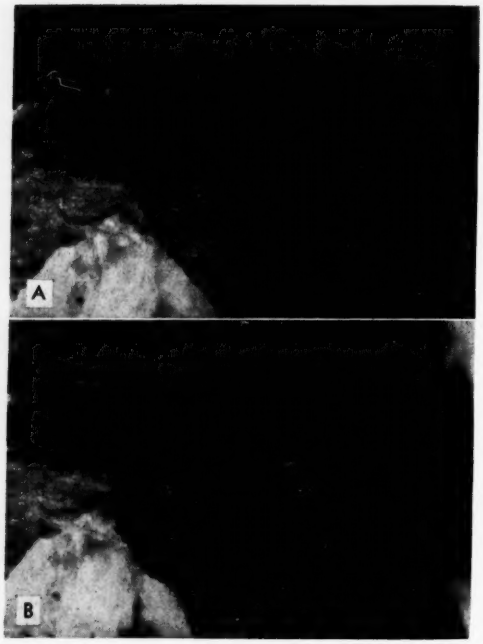

Fig. 7.—*A*, dorsal view of the duodenopancreas (M. A. S., a white Brazilian woman 77 years old). The choledochus is completely covered by the pancreatic "lingula." *B*, same specimen. The "lingula" shows the entire pancreatic portion of the duct.

In this second group, from the point of view of dissection, in practical application, one can establish two subgroups: 1. Cases in which the proximal part of the pancreatic portion of the choledochus is not covered by the pancreatic "lingula" but rather by loose conjunctive tissue easily permitting dissection directly over the choledochus; farther along, when one finds the pancreatic "lingula," the divulsion maneuver is used. 2. Cases in which the choledochus seems to penetrate the head of the pancreas. Its pancreatic portion is all or almost all surrounded by pancreatic tissue, sometimes of considerable thickness. The cleavage plane permits freeing of the small pancreatic "lingula," but its discovery even in the anatomic specimen is difficult, arduous and long; to my way of thinking, in this subgroup are included the cases unfavorable to the use of the divulsion method, or any other method so far known, in exposing the pancreatic portion of the choledochus. In view of these facts, a subdivision can be established for the cases with "lingulae" as favorable or unfavorable for the dissection of this portion of the choledochus, with the following frequency: adding up the cases in which the pancreatic "lingula" covered the choledochus duct only in its medial (20 cases) or distal (12 cases) portion, those in which it covered the entire of distal half (11 cases) and still covered the distal two-thirds (24 cases, or 12 per cent), one has 33.5 per cent, which, added to the 16.5 per cent of the group with no pancreatic "lingula," makes 50 per cent of the total. Therefore, in 50 per cent of the cases the choledochus is not covered by pancreatic tissue or is only partially so, at the most up to its distal two-thirds.

To this group one may add the fourth group, that is, the cases with two pancreatic "lingulae," inasmuch as the lips of both are juxtaposed at the level of the posterior face of the duct, either cranially

Fig. 8.—Posterior view of the duodenopancreas (A. S., a male Brazilian Negro 62 years old). Absence of pancreatic "lingula." Choledochus in a shallow furrow of the dorsal face of the head of the pancreas.

or caudally. The discovery of this type is very easy, depending only upon the section of the connective tissue present on the posterior outline of the duct. The percentage then rises to 59 per cent of the cases.

In general, it can be said that in 60 per cent of the cases the choledochus is perfectly accessible in its retropancreatic segment, as it is not, or only in a small extension, covered by the "lingula" or because it is covered by two "lingulae" whose lips are juxtaposed at the level of the posterior border of the duct.

In the remaining 40 per cent of the cases there was a very thick "lingula." The cleavage plane of this type is extremely difficult to identify. The duct is covered in all its extension, in its proximal two-thirds, or only in its proximal half.

From a racial viewpoint as concerns the white and Negro races, my data are isolated in the literature, since no other researcher has been specifically interested in the subject. The correlation of my results with those of other authors would still be more difficult, on account of their different criteria and the small number of cases of different ethnic groups.

The comparison with reference to sex is also difficult, owing to the diversity of criteria.

CONCLUSIONS

1. The single or double pancreatic "lingula" on the posterior face of the head of the pancreas, partial or totally covering the pancreatic portion of the choledochus, is a very frequent formation. It was observed in 83 per cent of the cases.

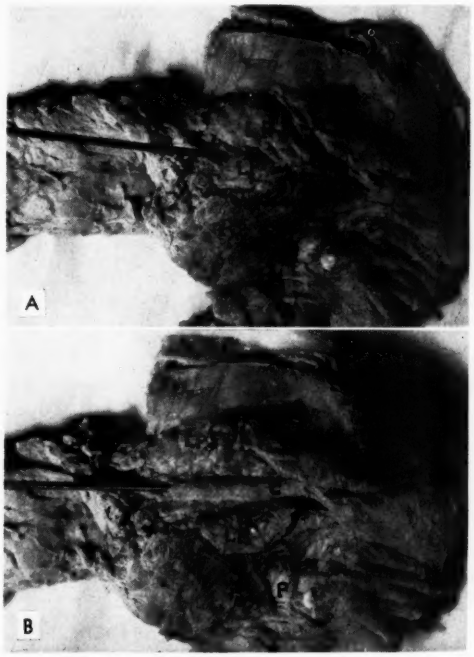

Fig. 9.—*A*, posterior view of the duodenopancreas (A. S., a white male Brazilian 35 years old). Probe placed in the lumen of the choledochus which is covered by a cranial and a caudal "lingula." *B*, same specimen. The two "lingulae" show the pancreatic portion of the common duct.

2. The absence of the "lingula" was verified in 16.5 per cent of the cases.

3. The prepancreatic choledochus is rare. It was observed in 0.5 per cent of the cases (1 observation in 200).

4. In all cases of pancreatic "lingula" there was a cleavage plane which permitted freeing it.

5. Practically, in 60 per cent of the cases, the choledochus in its retropancreatic portion was easily accessible, either because it was not covered by pancreatic tissue or was covered, only to a small extent, or was covered by two "lingulae," the lips of which were juxtaposed at the level of the posterior face of the duct.

6. In 40 per cent of the cases the "lingula" was thick. It covered the duct entirely (30 per cent of the cases), or in its proximal half. Under these conditions the isolation of the choledochus is very difficult.

7. The variations observed with reference to the two ethnic groups, Negro and white, and to the two sexes, presented no significant statistical differences.

SUMMARY

With the use of autopsy material, the pancreatic "lingulae" related to the choledochus were dissected in 100 white specimens (75 male and 25 female) and 100 Negro specimens (59 male and 41 female), of more or less pure racial strains as classified by the essential somatoscopic characters.

The specimens were fixed in 10 per cent solution of formaldehyde.

The observations are presented in five groups in decreasing order of frequency, some with subgroups, to which the transitional forms were subordinated.

Group 1: Cases of unique pancreatic "lingula" of caudal base and variable extension, partially covering the choledochus. This was observed in 39 Negro specimens (23 male and 16 female) and 46 white specimens (33 male and 13 female), 42.5 per cent of the total number.

Group 2: Cases of unique pancreatic "lingula" of the caudal base covering the entire pancreatic portion of the choledochus. This was observed in 34 Negro specimens (21 male and 13 female) and 26 white specimens (21 male and 5 female), 30 per cent of the total.

Group 3: Cases in which there was no pancreatic "lingula". The pancreatic "lingula" of the choledochus was merely juxtaposed to the posterior face of the head of the pancreas and adhered thereto by means of a coalescent membrane containing lymphatic, arterial and venous elements. It was observed in 14 Negro specimens (7 male and 7 female) and 19 white specimens (15 male and 4 female), 16.5 per cent of the total.

Group 4: Cases of double "lingula"; an upper one at the cranial base and a lower one at the caudal base, always juxtaposed to the free border. It was observed in 10 Negro specimens (6 male and 4 female) and 8 white specimens (5 male and 3 female), 9 per cent of the total.

Group 5: Cases in which there were less frequent morphologic variations. The subjects included 3 Negro and 1 white specimen—2 per cent of the total.

From the analysis of his results the author draws the following conclusions:

1. The small solitary or "double" pancreatic "lingula" on the posterior face of the head of the pancreas, partially or totally covering the pancreatic portion of the choledochus, is a frequent formation, having been observed in 83 per cent of the cases.

2. Absence of the "lingula" was verified in 16.5 per cent of the cases.

3. The prepancreatic choledochus is a rare anomaly. It was present in 0.5 per cent of the cases (one in 200).

4. In all cases of pancreatic "lingula" there was cleavage plane that permitted freeing it.

5. In virtually 60 per cent of the cases the choledochus in its retropancreatic portion is easily accessible, either because it

is not covered by pancreatic tissue or is so covered only in a small portion of its length, or because it is covered by two "lingulae", the lips of which are juxtaposed the level of the posterior face of the duct.

6. In 40 per cent of the cases the "lingula" is thick. It covers the duct entirely (30 per cent), in its proximal two-thirds or its proximal half. Under these conditions the isolation of the choledochus is made very difficult.

7. The variations observed with reference to the two ethnic groups and the two sexes provided no significant statistical variations.

ZUSAMMENFASSUNG

Die "Lingula" der Bauchspeicheldrüse und ihre Beziehung zum Ductus choledochus wurde an einem Sektionsmaterial von 100 Weissen (75 Männer und 25 Frauen) und 100 Negern (59 Männer and 41 Frauen) präpariert. Die Leichen waren nach Klassifizierung auf Grund der wesentlichen somatoskopischen Merkmale mehr oder weniger rasserein.

Die Präparate wurden in 10-prozentiger Formalinlösung fixiert.

Die gwonnenen Beobachtungen werden in fünf Gruppen nach Häufigkeit eingeteilt. Einige davon haben Unterbteilungen, in welche die Übergangsformen eingeordnet sind.

Gruppe 1: Fälle mit einer einzigen "Lingula" mit kaudaler Basis und von verschiedener Ausdehnung, die den Choledochus teilweise bedeckte. Dies wurde bei 39 Negern (23 männlichen und 16 weiblichen) und bei 46 Weissen (33 männlichen und 13 weiblichen), d.h. bei 42,5% des Gesamtmaterials beobachtet.

Gruppe 2: Fälle mit einer einzigen pankreatischen "Lingula" mit kaudaler Basis, die den ganzen pankreatischen Abschnitt des Choledochus bedeckte. Dies wurde bei 34 Schwarzen (21 männlichen und 13 weiblichen) und bei 26 Weissen (21 männlichen und 5 weiblichen), d.h. bei 30% des Gesamtmaterials beobachtet.

Gruppe 3: Fälle ohne pankreatische "Lingula." Die pankreatische "Linguala" des Choledochus lag nur in unmittelbarer Nähe der Hinterfläche des Pankreaskopfes, mit dem sie durch eine lymphatische, arterielle und venöse Elemente enthaltende verbindende Membran in Zusammenhang stand. Dies wurde bei 14 Negern (7 männlichen und 7 weiblichen) und bei 19 Weissen (15 männlichen und 4 weiblichen), d.h. bei 16,5% des Gesamtmaterials beobachtet.

Gruppe 4: Fälle mit doppelter "Lingula"; eine obere an der kranialen und eine untere an der kaudalen Basis, immer in unmittelbarer Nähe des freien Randes. Dies wurde an 10 Negern (6 männlichen und 4 weiblichen) und an 8 Weissen (5 männlichen und 3 weiblichen), d.h. an 9% des Gesamtmaterials beobachtet.

Gruppe 5: Fälle mit selteneren morphologischen Variationen. In dieser Gruppe befanden sich 3 Neger und ein Weisser, d.h. 2% des Gesamtmaterials.

Die Untersuchung seiner Beobachtungen führt den Verfasser zu folgenden Schlussfolgerungen:

1. Die kleine einzelne oder doppelte pankreatische "Lingula" an der Hinterfläche des Pankreaskopfes, die den pankreatischen Abschnitt des Choledochus teilweise oder völlig bedeckt, ist eine häufige Bildung, die an 83% der Fälle zur Beobachtung kam.

2. Das Fehlen der "Lingula" konnte an 16,5% der Fälle bestätigt werden.

3. Der präpankreatische Choledochus ist eine selten Anomalie, die nur in 0.5% der Fälle (bei einem unter 200) vorhanden war.

4. In allen Fällen von pankreatischer "Lingula" liess sich ein spaltförmiger Raum finden, der eine Freilegung der "Lingula" gestattete.

5. In etwa 60% der Fälle ist der retropankreatische Abschnitt des Choledochus leicht zugänglich, weil er entweder garnicht oder nur zu einem kleinen Teil von Pankreasgewebe überlagert ist, oder weil er von zwei "Lingulae" bedeckt ist, deren Lippen auf der Höhe der Hinterfläche des Gallengangs nahe beieinander liegen.

6. In 40% der Fälle ist die "Lingula"

dick und bedeckt den Gang entweder völlig (30%) oder nur zwei Drittel oder die Hälfte seines proximalen Abschnittes. In diesen Fällen ist die Freilegung des Choledochus sehr schwierig.

7. Die Unterschiede der Beobachtungen bezüglich der beiden ethnischen Gruppen und des Geschlechts ergeben wichtige statistische Daten.

RÉSUMÉ

En utilisant le matériel d'autopsie, les auteurs ont disséqué les "lingulae" pancréatiques chez 100 blancs (75 hommes et 25 femmes) et chez 100 nois (59 hommes et 41 femmes).

Le matériel fut fixé dans une solution à 10% de formaline.

Les observations furent divisées en 5 groups.

Groupe 1: Cas d'une "lingula" pancréatique unique recouvrant partiellement le cholédoque. Il fut observé chez 39 noirs (23 hommes et 16 femmes) et chez 46 blancs (33 hommes et 13 femmes), soit 42.5% du total.

Groupe 2: Cas d'une "lingula" pancréatique recouvrant entièrement la portion pancréatique du cholédoque. On l'observa chez 34 noirs (21 hommes et 13 femmes) et chez 26 blancs (21 hommes et 5 femmes), soit 30% du total.

Groupe 3: Cas chez lesquels il n'y avait pas de "lingula" pancréatique. On a observé cette variété chez 14 noirs (7 hommes et 7 femmes) et chez 19 blancs (15 hommes et 4 femmes), soit 16.5% du total.

Groupe 4: Cas de double "lingula" pancréatique. On en a observé chez 10 noirs (6 hommes et 4 femmes) et chez 8 blancs (5 hommes et 3 femmes), soit 9% du total.

Groupe 5: Cas chez lesquels on remarqua des variations morphologiques moins fréquentes. Ils comprenaient 3 noirs et 1 blanc, soit 2% du total.

L'auteur tire des conclusions tres intéressantes.

(Pour leur donner toute leur valeur, il est préférable, afin d'éviter les malentendus, de lire le texte original.)

RESUMEN

En autopsias se disecó la língula pancreática relacionada al colédoco en 100 especímenes blancos (75 hombres y 25 mujeres) y en 100 especímenes negros (59 hombres y 41 mujeres), con tipos raciales más ó menos definidos basándose en las características somáticas esenciales.

Los especímenes fueron fijados en una solución de formaldehido al 10 por ciento.

Las observaciones se presentan en cinco grupos en orden decreciente de frecuencia, las formas transicionales se subordinaron a subgrupos.

Grupo 1: Casos de "lingula" pancreática única de base caudal y extensión variable, cubriendo parcialmente al colédoco. Esto fué observado en 39 especímenes de negro (23 hombres y 16 mujeres) y 46 especímenes de blanco (33 hombres y 13 mujeres), en total fué 42.5 por ciento.

Grupo 2: Casos de "língula" pancreática única de base caudal cubriendo completamente la porción pancreática del colédoco. Esto fué observado en 34 especímenes de negro (21 hombres y 13 mujeres) y 26 especímenes de blanco (21 hombres y 5 mujeres), en total fué 30 por ciento.

Grupo 3: Casos en los cuales no había "língula" pancreática. La "língula" pancreática del colédoco estaba unicamente anexa a la cara posterior de la cabeza del páncreas ó adherida a ella por medio de una membrana coalescente conteniendo elementos linfáticos, aretriales y venosos. Esto fué observado en 14 especímenes de negro (7 hombres y 7 mujeres) y 19 especímenes de blanco (15 hombres y 4 mujeres), en total fué 16.5 por ciento.

Grupo 4: Casos de doble "língula," una superior de base craneal y otra inferior de base caudal, siempre anexas al borde libre. Esto fué observado en 10 especímenes de negro (6 hombres y 6 mujeres) y 8 especímenes de blanco (5 hombres y 3 mujeres) en total fué 9 por ciento.

Grupo 5: Casos en los cuales hubieron variaciones morfológicas menos frecuentes. Incluyen 3 especímenes de negro y 1 espécimen de blanco, 2 por ciento en total.

Del análisis de sus resultados el autor deriva las siguientes conclusiones:

1. La "língula" pancreática pequeña, solitaria ó doble, en la cara posterior de la cabeza del páncreas cubriendo parcial ó completamente la porción pancreática del colédoco es una estructura frecuente, habiéndose observado en el 83 por ciento de los casos.

2. Se comprobó ausencia de "língula" en el 16.5 por ciento de los casos.

3. El colédoco prepancreática es una anolmalía rara. Se presentó en el 0.5 por ciento de los casos (uno en 200).

4. En todos los casos de "língula" pancreática se encontró un plano de despegamiento que permitió spararla.

5. Virtualmente, en el 60 por ciento de los casos, el colédoco en su porción retropancreática es facilmente accesible, ya sea por que no se encuentra cubierto por tejido pancreático ó por que se encuentra cubierto unicamente en una pequeña parte de su longitud, ó por que se encuentra cubierto por dos "língulas" cuyos labios estan yuxtapuestos al nivel de la cara posterior del conducto.

6. En el 40 por ciento de los casos la "lingula" es gruesa. Cubre el conduc- completamente (30 por ciento) en sus dos tercios proximales ó en su mitad proximal. Bajo estas circunstancias el aislamiento del colédoco se hace díficil.

7. Las variaciones observadas con referencia a los dos grupos étnicos y a los dos sexos provee variaciones estadísticas significativas.

RESUMO E CONCLUSOES

O autôr procedeu um cuidadoso e interessante estudo anatômico, tomando por base 100 brances e 100 negros, os quais foram por si autopsiados.

Dividio os especimens estudados em cinco grupos, e da analise detida sôbre suas observações, chegou as seguintes conclusões:

1. A pequena e isolada, ou dupla "lingula" pancreatica na face posterior da cabeça do pancreas, cobrindo pacrcial ou totalmente a porção pancreatica do coledoco, é uma formaçãi frequente, havendo sido observada pelo autôr em 83% dos casos.

2. A ausencia da "lingula" foi constatada em 16.5% das autopsias.

3. A localisação pre-pancreatica do coledoco é uma anomalia rara, tendo sido constatada em apenas 0,5% dos casos (1 em 200 observações).

4. Em todos os casos de "lingula" pancreatica existia um plâno de clivagem que permitia a sua libertação.

5. Em aproximadamente 60% dos casos o coledoco em sua localisação retropancreatica foi facilmente accessivel, tanto por não estar coberto pelo tecido pancreatico, como nos casos em que foi coberto em pequena extensão do seu trajeto, ou ainda por ter sido êle coberto pois duas "lingulas," os labios das quais estavam juxtapostos ao nivel da face posterior do canal.

6. Em 40% dos casos a "lingula" é delgada, cobrindo inteiramente o coledoco em 30% dos cadaveres, na sua metade ou nos seus dois terços proximais. Em tais casos a liberatação do coledoco foi conseguida com grande dificuldade.

7. As cariações observadas com relação aos dois grupos raciais e aos dois sexos dos cadaveres estudados, representam as variações estatisticas de esabalho.

RIASSUNTO

Con l'autopsia fu dissecata la lingula pancreatica in rapporto col coledoco in 100 bianchi (75 maschi e 25 femmine) e in 100 negri (59 maschi e 41 femine), di razza più o meno pura così come è classificata dai caratteri somatoscopici essenziali. I camjioni vennero fissati in formaldeide al 10%.

Le osservazioni vengono presentate in 5 gruppi in ordine decrescente di frequenza, qualcuno con sottogruppi, ai quali sono subordinate le forme di transizione.

Gruppo 1. Casi di lingula pancreatica unica e di variabile estensione, parzialmente ricoprente il coledoco. Ciò fu osservato in 39 soggetti negri (23 maschi e 16 femmine) e in 46 soggetti bianchi (33 maschi e 13 femmine) : 42,5% del totale.

Gruppo 2. Casi di lingula pancreatica unica ricoprente interamente la porzione pancreatica del coledoco. Ciò fu osservato in 34 soggetti negri (21 maschi e 13 femmine) e in 26 soggetti bianchi (21 maschi e 13 femmine) : 30% del totale.

Gruppo 3. Casi in cui non vi era la lingula pancreatica. La porzione pancreatica del coledoco era semplicemente giustapposta alla faccia posteriore della testa del pa, creas e aderiva per mezzo di una membrana contenente elementi linfatici, arteriosi o venosi. Ciò fu osservato in 14 soggetti negri (7 maschi e 7 femmine) e in 19 soggetti bianchi (15 maschi e 4 femmine) : 16,5% del totale.

Gruppo 4. Casi di lingula doppia. Ciò fu osservato in 10 soggetti negri (6 maschi e 4 femmine) e in 8 soggetti bianchi (5 maschi e 3 femmine) : 9% del totale.

Gruppo 5. Casi in cui vi erano variazioni morfologiche ancor più rare. I soggetti includono 3 negri e un bianco 2% del totale.

Dall'analisi dei risultati l'autore trae le seguenti conclusioni:

1. La lingula pancreatica unica o doppia sulla faccia posteriore della testa del pancreas, che ricopra parzialmente o totalmente la porzione pancreatica del coledoco, è una formazione frequente, essendosi potuta osservare nell'83% dei casi.

2. L'assenza della lingula si verificò nel 16,5% dei casi.

3. Il coledoco prepancreatico è una rara anomalia. Fu presente nel 0,5% dei casi (1 su 200).

4. In tutti i casi di lingula pancreatica era presente un piano di clivaggio che permetteva di liberarla.

5. Nel 60% dei casi il coledoco retropancreatico è facilmente accessibile, sia perchè non ricoperto da tessuto pancreatico o ne è ricoperto solo in piccola parte, sia perchè è ricoperto da due lingule le cui labbra sono giustapposte a livello della faccia posteriore del dotto.

6. Nel 40% dei casi la lingula è spessa. Essa ricopre interamente il dotto (30%), nei suoi due terzi prossimali o nella sua metà prossimale. In queste condizioni ferenti gruppi etnici e nei due diversi sessi costituiscono notevoli variazioni statistiche.

7. Le variazioni osservate nei due dif- l'isolamento del dotto presenta una certa difficoltà.

BIBLIOGRAPHY

Baldwin, W. M.: The Pancreatic Ductus in Man, Together with a Study of the Microscopical Structure of the Minor Duodenal Papilla, Anat. Record 5:197-228, 1911.

Belou, P.: Anatomia de los conductos biliares y de la artera cistica, Buenos Aires, Impr. Oceanal, 1915.

von Büngner, O.: Zur Anatomie und Pathologie der Gallenwege und der Pankreas, Brun's Beitr. 39:131-139, 1903.

Bustos, F. M.: Tactica quirurgica en la litiase del hepatocoledoco. Extraccion de los calculos encastillados en el colédoco terminal y en la papila, Bol. y Trab. Acad. Argent. de Cirurgia 35: 509-510, 1951.

*Cameron, G.: Pancreatic Anomalies: Their Morphology, Pathology and Clinical History. Alvarenga Prize Essay, University of Melbourne, Victoria, Australia, 1924.

Chlyvitch, A., and Kozintsev, A.: Plan de clivage pancréatique comme voie d'abord vers le segment dit intraglandulaire du cholédoque. (Recherches sur les rapports due cholédoque avec le tissue pancréatique), Ann. d'Anat. Pathol. 14: 505-511, 1937.

Degni, M.: Technical and anatomic contribution to the surgery of the choledochus duct (with surgical anatomic data of pancreatic ducts). Thesis, São Paulo University of Medicine, 1945.

Finochietto, R.: Choledochus; Surgical Importance of the Pancreatic Portion, Rev. Cir. Buenos Aires 21:461-470, 1942.

**de Freitas, J.: Contribution to the Treatment of the Duodenal Stump in Gastrectomies Perforating Peptic Ulcer of the Pancreas Head. Thesis, University of Medicine, Rio de Janeiro, Borzoi, 1948.

de Freitas, J.: Treatment of the Duodenal Stump in Gastrectomies Through Perforating Peptic Ulcer of the Pancreas Head (New Technical and Tactical Procedure). Thesis, University of Medicine of Rio de Janeiro, 1950.

Fuchs, F.: Zur chirurgischen Anatomie des justaduodenalen Choledochusabschnittes, Arch. f. klin. Chir. 139:124-134, 1926.

Helly, K. K.: Beitrag zur Anatomie des Pankreas und seiner Ausfuhrungsgange, Arch. f. mikrosk. Anat. 52:773-793, 1898.

Leiva, C. M.: Anatomia del duodeno-pancreas, Arch. Chil. Morfol. 5:79-153, 1943.

Letulle, M., and Nathan-Larrier, L.: Region veterienne du duodenum et ampoule de Vater, Bull. Soc. Anat. Paris, sér. 5è., 12:491-506, 1898.

Letulle, M., and Nathan-Larrier, L.: L'ampoule de Vater. (Étude anatomique et histologique), Arch. Sc. Med. 3:180-196, 1898.

Maeda, W.: Cited by Yamaguchi, K.: Zur topographischen Anatomie des Duodenum, Acta Scholae Med. 7:1, 1924.

Näätänen, E.: Ueber die gegenseitigen Beziehungen swischen den Panckreasgangen und den Gallengangen, Ztschr. f. anat. u. Entwicklungsgesch. 111:355-364, 1941.

Nogueira, P.: Technique and Tactic in Calculosis of the Hepatic Choledochus. Thesis, São Paulo: Ed. Tecn. Brasil, Ltda., 1944.

Nuboer, J. F.: Studien über das extrahepatische Gallenwegs-system, Frankfurt Ztschr. f. Pathol. 41:198-249, 1931.

Padula, F.: il calibro del dotto coledoco, Ann. Med. Navale 9:4, 1903.

Robinson, B.: Landmarks in the Biliary and Pancreatic Ductus, M. Rec. 72:297-303, 1907.

Ruge, E.: Beitrage zur chirurgischen Anatomie der grossen Gallenwege, Arch. f. klin. Chir. 87:47-78, 1908.

Sterling, J.: The Termination of the Common Bile Duct, Rev. Gastroenterol. 16:821-845, 1949.

Wiart, P.: Recherches sur l'anatomie topographique et les voies d'accés du choledoque. Thesis Doct., Paris: G. Steinheil, 1899.

Wyss, O.: Cited by Helly, K. K.: Zur Aetiologie des Stauungsikterur, Virchow's Arch.

***Yamaguchi, K.: Chirurgische Anatomie des Gallensystems beim Japenen, Kaibo Z. Tokio 81: 191-229, 1930.

*We express our thanks to Leigh Scott of the Melbourne University Library for sending this work at our request.

**We thank the author for sending his thesis.

***The title in the German language corresponds to the data furnished by the author himself who kindly sent us the original work, published in Japanese, for the translation of which we are thankful to Mr. Fumio Chiba and collaborators.

Aristotle, in spite of his reputation, is full of absurdities. He says that children should be conceived in the winter, when the wind is in the north, and that if people marry too young the children will be female. He tells us that the blood of females is blacker than that of males; that the pig is the only animal liable to measles; that an elephant suffering from insomnia should have its shoulders rubbed with salt, olive oil, and warm water; that women have fewer teeth than men, and so on. Nevertheless, he is considered by the great majority of philosophers a paragon of wisdom.

Superstitions about lucky and unlucky days are almost universal. In ancient times they governed the actions of generals. Among ourselves the prejudice against Friday and the number 13 is very active; sailors do not like to sail on a Friday, and many hotels have no 13th floor. The superstitions about Friday and 13 were once believed by those reputed wise; now such men regard them as harmless follies. But probably 2,000 years hence many beliefs of the wise of our day will have come to seem equally foolish. Man is a credulous animal, and must believe *something;* in the absence of good grounds for belief, he will be satisfied with bad ones.

—*Russell*

Intestinal Suturing and Plication

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THE chosen methods of good surgeons tend to establish surgical technics. Deserved respect and admiration may blind students to basic principle and cause it to be forgotten. Yet, as better understanding comes with time, basic facts change.

Attention is turned so much toward method that "acceptable practice" acts to limit the improvement of method. This is not a new thing in our history.

Galen taught "This is what I do." Respect for that great teacher brought science in medicine to a pause of four hundred years. If Galen had been humble enough to debate "This is what I believe *now*," we might not have recorded his name, but we should owe him more.

The teaching of technics in some centers resembles indoctrination. I hear "Intestinal suturing is always by interrupted cotton or silk in the hands of the better men." This well-learned and obfuscating dogma of technic puts basic principle out of consideration. There is good reason to think back and then reassess the importance of basic aim in therapy.

Recent centuries have been studded with researches on the "prophylaxis of adhesions." Failure has been the honest report of all workers.

In 1850 it was agreed that lysis of adhesions increased the disorder and the disability.[1]

Control of adhesion re-formation after lysis has been an added and new concept since 1920. Plication has changed basic principle and so has added new method. First reported in 1937,[2] it has restored a normal intestinal physiologic status to the intestinal cripple from adhesions. Many have reported this result.[3] The picture of intestinal obstruction has been altered and brought under reasonable control.[4]

The work of Boys[1] properly placed a period to further research on the prophylaxis of adhesions.

A guide to new principles has been obtained from study of patients with advanced acute peritonitis and with extensive adhesions involving most of the small bowel in cases of multiple obstruction.[5] With both disorders, obstructions are multiple, and many may be complete when first seen. No tube can advance past the first of the complete obstructions. Therefore, time given to study of water balance, electrolyte replacement, etc., will be harmful if it extends past the need of preoperative preparation. There, of course, it is vitally important and life-saving.

Given, then, the need for plication and an understanding of its service, there is need for close inspection of certain basic principles of suturing if plication is to serve at its best.

1. The service supplied by the suture material is to hold loops of intestine in apposition through the time of their uniting.

2. The type of stitch controls the kind of apposition.

3. The late result, years later, can be controlled as needed by varied technics of plication.

The time of uniting varies with the presence or absence of peritonitis.

In the presence of peritonitis, I have seen loops of small bowel stick so tightly together in a space of ten minutes that a mild form of blunt dissection was required for their separation. First dissection preparatory to plication is therefore not done extensively, and the bowel is plicated as the dissection liberates intestinal fixations at abscess sites.

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In the absence of peritonitis existing at the beginning of the operation for adhesion obstruction, uniting of the plicated bowel will depend upon the inflammation of healing, or a form of peritonitis. This may be in response to trauma or suture peritonitis.[6] There must be some effective peritonitis for satisfactory union. The use of a theoretical nonirritating suture material is open to serious debate.

Since uniting is so prompt in the presence of peritonitis, I use the suture material quickest to disappear. Plain No. 00 or chromic No. 00 catgut is preferred, because of the absorbable character of the materials and because finer catgut tears through the fragile substance of edematous intestinal wall. I see no equal value in any nonabsorbable material. All nonabsorbable material should be used in interrupted stitches, and these have many disadvantaages in cases of advanced acute peritonitis.

The kind of apposition and union desired between loops of plicated intestine is not left to chance. A continuous line of union, as compared with a sort of spot welding, offers the choice to be made.

In the garment trade zippers have replaced buttons and buttonholes, because "gaposis" is a recognized pathologic entity. After plication of the bowel, there may be traumatic ileus or ileus due to existing peritonitis or any of several other causes. Local distention may tear spot welding points apart and defeat the whole operation. At best, I have seen spots so united by interrupted sutures separate, with long lines of rope adhesion connecting them, later. I argue constantly against interrupted suturing.

Thomeret[7] has decided that there is no need to begin the suture line at the base of the mesentery. He does not sew the mesentery.[8] Others begin the suture line at the apex of the fold of plication, making the mesenteric approximation last. I am thoroughly in favor of differences of viewpoint, and so continue advocating the beginning of the suture at the base of the mesentery, using continuous sutures, and absorbable material.

There is a feature not to be overlooked: In the use of interrupted sutures, it takes consideraably longer to tie 100 knots than it does to insert 50 continuous sutures, or less.[9] Time, in all cases of advanced peritonitis, or of extensive obstructing adhesions, is a very limited commodity.

So, for better linear approximation of plicated bowel, for the avoidance of "gaposis" and for the sake of time under the stress of the patient's grave condition, I recommend the use of continuous sutures in all cases. This type of stitch gives the kind of apposition of intestinal surfaces that has proved most satisfactory, both at the time of operation and during the years of freedom from disability resulting therefrom.

The desired end result of plication of various segments or lengths of intestine calls for different purposes and aims. Varied technics of plication suturing may supply that result for the patient in the years ahead. It may be that the form of the intestine in plication should be maintained forever, as has been noted with regard to the use of plication to correct intussusception.[10] It may be that one desires the dynamic activity of peristalsis to stretch the peritoneum and so returns the plicated intestine to normal shape and appearance, as with plicated sigmoid.

A review of case experiences may serve to exemplify enough of the purposes of plication and consequent need for varied suturing technics to clarify some of the thinking on these matters.

REPORT OF CASES

CASE 1.—A man aged 40 had complete obstruction due to adhesion bands after a right rectus appendectomy, without peritonitis at the time of operation. The second operation was simple lysis of the bands.

The obstruction returned within one year, requiring a third operation. Again this was simple lysis of adhesions.

Symptoms persisted. There was repeated intubation for distention. An elective operation "with plication" was done as the fourth surgical procedure.

In the patient's opinion there was no im-

provement. Intubation had to be repeated frequently. Plication was considered "ineffective because of some neurologic disturbance to the mechanism of peristalsis."

I first saw the patient after this final determination had been made. He showed all the evidences of partial intestinal obstruction; dilated loops of small bowel with detectable splash, obstinate inability of the intestinal tract to function. He was prepared, and his fifth surgical experience was undertaken.

As a matter of preference, I consider the ileocecal juncture the point of beginning of orderly dissection and plication, recognizing the fact that in some instances a great deal of work must be done before this region can be reached. Intestine fused tightly to the abdominal wall offered some delay in the approach to the cecum.[11]

The method of the previous plication was easy to see, being marked clearly in black silk knots. The loop of plication nearest the cecum, arbitrarily called the first wing because I choose to deal with it first, was not done as recommended. The apex of the V of the plicated loop should be pointed toward the patient's chin.[12] In this instance it was pointed downward and into the pelvis. The loop was about 10 inches (25 cm.) in length, involving some 20 inches (50 cm.) of ileum.

This first wing of plication was fused solidly to the peritoneal floor of the pelvis, with the sigmoid firmly fixed to its upper surface. Around it and under its mesentery, other loops of free small bowel had become adherent. This intestinal tangle was dissected without disturbing the form of the plication, which was studied carefully.

All black knots had been tied snugly and cut close. I inspected 100 knots for statistical calibration. More than 80 had no contact with at least one of the two original parts of intestine into which it had been sewn. Many had no contact with both walls of the plicated intestine. If the nonabsorbable suture will cut away from one loop of apposed intestine; what is the need of asking it to remain longer than it takes to cut through the intestinal peritoneum?

Spot union with spot welding is good only when the welded parts have rigidity of themselves, permitted gaposis between silk sutures. Some of these had made local fibrin union at the point of suture, and time had made this union stretch out into a band. Danger was offered to free loops of small bowel.

Why had there been fibrin union? Had it been due to suture peritonitis of the "nonirritating" silk, or was it due to the tissue necrosis from the tied knot? Had surgical trauma been a causative factor? As long as we can be uncertain, there is chance for growth in surgery.

The case for interrupted sutures and nonabsorbable material lost ground as I inspected this end result of former plication.

I severed all adhesions, including those made by the plication that had been done. I plicated the entire small bowel, beginning at the cecum and ascending to the ligament of Treitz. I used continuous No. 00 chromic catgut. Following the recommendation of Thomeret,[13] since this patient had already undergone too many operations, I left no loop of normal intestine unplicated.[14] There was much of the small bowel that showed no adhesions, but the preventive plication of all bowel insures that there will be no adhesion obstruction and no interference with normal physiologic function.

This patient made an uneventful recovery to a normal intestinal physiologic status. He has remained symptom-free for the first time since the adhesions began. At the time of writing, more than two years have passed.

CASE 2.—C. G., a woman, was seen at the age of 19 and again at the age of 23. In her case an aim in plicating was successfully accomplished.

The peritoneal sac of a hernia suggests the future of a loop of plicated small or large bowel. The ability of the peritoneum to expand to a great extent over an enlarging hernia is taken for granted, having been observed so frequently.

The dynamics of intestinal activity after plication put considerable pressure on the united lines of sutured peritoneum.[14] Peritoneum regenerates along fibrin bundles,[15] so that point union should be expected to give rise to bands of stretched adhesions. Linear union of plicated loops of bowel may be followed by stretching of peritoneal sheets, similar to the formation of the herniae sac. These are observed facts. We use the lessons learned.

In C. G., peritonitis developed from a ruptured appendix. She spent three months in the hospital, never free of distension or the need of tubation. The loss in weight was continuous. The course of convalescence was disturbing, in that improvement was transitory but frequently promising. The need of plication was recognized and it was therefore done.[16]

There were small abscesses at the mesenteric base all along the small bowel. There was little destruction of peritoneum along the intestine itself. Partial obstructions were multiple and due to fixations over abscess sites. After liberation of all abnormalities the entire small bowel was plicated, No. 00 chromic and continuous sutures being used.

Return to health and symptom-free well-being was uneventful. A year after marriage the patient came to operation for simple ovarian cyst, and inspection of the former field of peritonitis was possible.

In plicating, only the peritoneum was included in the stitches. Linear approximation of peritoneal surfaces was accomplished by continuous suture and by wrinkling the bowel along the taut suture. (This is the opposite procedure from the occasionally seen support of loops by instrument, so that after suturing there are open spots between surfaces that should be solidly apposed.) The physicians who had treated the original peritonitis and plication were again assembled when the operation for the cyst was performed. Photographs had been taken of the first operation and plication.

When the abdomen was opened there was no evidence of the former plication. In four years peristalsis had stretched the peritoneum so that all small bowel was free on its mesentery as if nothing had been done. On close inspection with parallel ray light, stress lines could be seen, clearly indicating the stretching of the peritoneum. There was no spot union, and consequently no bands of adhesions were scattered along the bowel. Like the peritoneum of a herniae sac not exposed to truss pressure, the small bowel peritoneum seemed close to normal.

(This case warrants a contrasting note. Plication at the site of reduced intussusception offers insurance of no return. Bearing in mind the ability of the peritoneum to stretch, I do not use simple peritoneal suturing with intussusception. The peritoneum is incised and subperitoneal tissue is sewed together for certain permanence. This variation of plication suture is reasonable and is performed for a definite purpose.

In a current volume on surgery, the treatment of recurrent intussusception is dismissed with "Recurrence is rare." The Mayos reported the case of an infant with three intussusceptions of the same segment of bowel in one year.[16] One case is enough to warrant adding one minute to the time of operation to effect plication in permanent form at the site of intussusception. The union of subperitoneal layers is the obvious means of securing permanent prevention of intrussusception.)

In the case of C. G., since plication with complete linear apposition of peritoneal surfaces was all that was needed, it did not matter whether the plication remained forever or whether the peritoneum stretched on planes to reform again the apparent condition of normality.

The suturing of the plication in the case of C. G. was done with No. 00 chromic catgut and continuous stitch for each loop. This lasted throughout the time needed for uniting. Apposition in a continuous plane or surface was desired because of need for eliminating bands from local point stretching of united peritoneum in the years to follow. The late and final result was a return to apparent normality, due to the kind of suture material used and the stitch with which it was applied.

CASE 3.—The case of this patient, a woman, belonged to another physician and demonstrates a complication that might accidentally affect statistics.

The patient had undergone operation for pelvic disease, with need for recurrent release of obstructive symptoms. Finally she came to Dr. L. C., who untangled the entire small bowel from adhesion fixation obstructions. After three months of complete relief from symptoms, sudden partial obstruction occurred. Quick relief followed intubation. Roentgenograms demonstrated no lag, no pocketing and no evidence of abormality.

Repeated similar bouts brought the patient to reoperation for "adhesions." The plicating surgeon, L. C., was doubtful as to his application of the technic. There had been so much peritoneum destroyed before his plication that his doubt was based on the possibility of cicatricial contracture of some loop, without roentgen evidence.

When the abdomen was opened, since I begin at the cecum for all inspection, I saw the spontaneous unfolding of an intussusception of the terminal portion of the ileum into the cecum through a rather large ileocecal ring. There was no peritoneal fibrin deposit to indicate previous inflammation, and this was taken to explain the mildness of the symptoms and the ease of recovery from each bout.

Plication of the terminal portion of the ileum was done, that least segment of small bowel being brought against the longitudinal

white bands of the ascending portion of the colon. Subperitoneal tissues were exposed and sewed together with No. 00 continuous chromic catgut, as with all intussusceptions.

The plication of the small bowel as it had been done was in permanent position because of the immense damage to the peritoneum. There was no evidence of any malfunctioning part of the small bowel, this corroborated the roentgen observations.

The patient made a quick recovery and has remained symptom-free more than five years.

CASE 4.—The patient was Mrs. C., 30. The eight months preceding her admission had seen the continued use of Levine or Miller-Abbott tubes. Her weight had gone from 120 to 59 pounds (54.4 to 26.8 Kg.). The abdomen was greatly distended and silent.

There had been 4 previous operations. In the effort to prevent adhesions, hyaluronidase had been used in the peritoneal cavity.

The entire anterior abdominal wall was fused to loops of small bowel, the omentum being scant and in the upper part of the abdomen. Most difficult sharp dissection was necessary throughout the length of the small bowel and its mesentery. Not as much as one square inch of glistening peritoneum was identified along the small bowel or its mesentery.

The silent abdomen suggested paralytic ileus due to obstruction and disuse. The trauma of resolving the pathologic condition would add to this. I began pituitrin on admission in anticipation of difficulties arising from an adynamic ileus.[17] An ampule of the stronger concentration was given hourly.

Little is known that would provide a reasonable measure through which one might anticipate return to normal peristaltic activity. The normal functions of secretion and absorption of the small bowel may be restored, too, after release from obstruction, but again, when?

Pituitrin was continued until several days after there had been apparent return of a normal intestinal physiologic picture.

In plicating the entire small bowel, I saw that sutures need serve for only a few minutes. Separated loops stuck fast as soon as they were dropped after liberation. An interesting observation came from the beginning of peristalsis under the influence of heavy doses of pituitrin. As loops were freed from their obstructing adhesions, peristalsis became active. The new sticking together by the accident of position after dissection and in view on the abdomen was not disturbed by the most active peristalsis. I have noticed this many times. I have, accordingly, little faith in the idea that anything can dissolve or break up or prevent adhesions, where it is the natural response to insult or effort to heal the peritoneum.

Careful linear approximation of intestinal loops in plication, and as careful folding and suturing of the mesentery, were done from cecum to the ligament of Treitz.

Since there was no visible or identifiable peritoneum and since the adhesion of the antimesenteric surfaces to the anterior abdominal wall was expected, there was little doubt that this plication of this bowel would be permanent. I have noted in many patients that fusion to the abdominal wall is of no consequence and is not productive of symptoms when continuous plication has been done.[18]

This patient has recovered normal weight, normal physical activity, normal appetite and normal freedom from the apprehension of return of obstructive symptoms. More than a year has passed since this recovery.

In conclusion, no discussion of suturing is complete without mention of the work of several men.

Robert Smith[19] has proved beyond argument what may result from the use of certain suture material in plication. Cotton may set in motion a slow softening of the intestinal wall. This he showed in photomicrographs.

Thomeret noted the tendency of some patients to respond generally to local suturing of intestine, and so advocated complete plication of all small bowel in every case, to eliminate wandering fibrin bands that may obstruct loops of undamaged and unplicated bowel. I have had 2 cases in which this would have been warranted; 2 cases in thirty-four years and some 1,300 cases. Statistically, the percentage is against total plication in all cases, but every case is 100 per cent, whatever direction it may take.

Donaldson and Cameron[20] considered silk to be less productive of adhesion formation. Their work was done with laboratory animals. The question may well be, does one not want quick adhesion formation during the first hours of union after plication?

In considering the works of Ripstein,[21]

Lord, Howes and Jolliffe, and others, one may come to the understanding that suturing in every case need not be the same; and that plication effected by any means is adequate to handle the conditions of obstruction from adhesions or from peritonitis.

SUMMARY

The author discusses suturing in plication, which in his opinion, should accomplish three things:

1. It should hold the mesentery and intestine as sewn only through the minutes required for primary union.
2. It should provide linear apposition of surfaces as contrasted to spot union.
3. It should be controlled by the need for permanent union or for temporary fixation with expected stretching of surfaces.

The author therefore uses absorbable material, continuous stitches, and peritoneal or subperitoneal union as required continuing now as he began the first plication in 1920.

ZUSAMMENFASSUNG

Der Verfasser erörtert das Nähen in Falten, das sich nach seiner Ansicht für die folgenden drei Zwecke eignet:

1. Die Faltennaht sollte Mesenterium und Därme nur für die Minuten, die zur primären Vereinigung erforderlich sind, in Position halten.
2. Die Faltennaht gestattet im Gegensatz zur Punktnaht eine lineare Angleichung von Oberflächen.
3. Die Anwendung der Faltennaht sollte davon abhängen, ob ein Bedürfnis nach endgültiger Vereinigung oder vorübergehender Fixierung in Fällen, wo eine Dehnung der Oberflächen zu erwarten ist, besteht.

Der Verfasser benützt weiterhin, so wie er es seit seiner ersten Fältelung im Jahre 1920 getan hat, absorbierbares Material, fortlaufende Nähte und-je nach Bedarf-peritoneale oder subperitoneale Vereinigung.

RÉSUMÉ

L'auteur discute la duplicature intestinale, laquelle, d'après lui, devrait respecter trois faits :

1. Cette duplicature devrait réunir les surfaces du mésentère et celles de l'intestin.
2. Cette façon de procéder devrait empêcher la formation d'adhérences.
3. Cette duplicature devrait être faite, selon les cas, temporairement ou d'une façon définitive.

Dans ce but, l'auteur utilise du matériel résorbable, une suture continue, poursuivant la méthode qu'il avait utilisée pour la première fois en 1920.

RESUMEN

El autor discute sutura en el plegamiento intestinal (plication), que en su opinión debe de lograr tres cosas:

1. Debe sostener el mesenterio e intestino, cosiendo con la minuciosidad requerida para la unión primaria.
2. Debe de proporcionar una adaptación lineal de las superficies.
3. Debe ser controlada por las necesidades de una unión permanente ó por una fijación temporal en la que se espera estiramiento de las superficies.

Por consiguiente, el autor usa material inabsorbible, suturas continuas y unión peritoneal ó subperitoneal segun se requiera, continuando actualmente en la misma forma en que hizo su primer plegamiento peritoneal en 1920.

RIASSUNTO

L'autore sotiene un metodo di sutura che, nella sua opinione, risponde a tre requisiti:

1. Mantiene uniti il, mesentere e l'intestino solo per il tempo necessario all'unione primaria.
2. Consente un affrontamento lineare delle superfici.
3. Può servire tanto per fissazioni permanenti come temporanee.

L'autore materiale riassorbibile e suture continue.

REFERENCES

1. Boys, F.: The Prophylaxis of Peritoneal Adhesions, Surgery **11**:118-168, 1942. See also p. 4.
2. Noble, T. B.: Plications of Small Intestine as Prophylaxis Against Adhesions, Am. J. Surg. **25**:41-44, 1937.
3. More than 200 personal communications and discussions of cases; active file of correspondence and magnetic tapes.
4. Noble, T. B.: (a) Acute Peritonitis, J. Internat. Coll. Surgeons **14**:66-81, 1950. (b) Peritonitis, Intestinal Obstruction and Wound Dehiscence, ibid. **17**:768-780, 1952. (c) Paralytic Ileus from Peritonitis After Appendicitis, Am. J. Surg. **84**: 419-428, 1952. (d) Boys.[1]
5. Noble, T. B.: The Place of Plication in the Treatment of Peritonitis, J. Internat. Coll. Surgeons **12**:313-319, 1942. Perforating Wounds of the Intestine, Am. J. Surg. **62**:50-58, 1943.
6. Noble, T. B.: The Treatment of Peritonitis and Its Aftermath. Indianapolis: A. V. Grindle, 1945, pp. 125-134.
7. Thomeret, G.: L'operation de Noble: Occlusion intestinale. Paris: G. Doin et Cie, 1953. L'operation de Noble dans occlusion in estinale, Les entretiens de Bichet 1951 (vol. chirurgicale), pp. 129-132. Operation de Noble: Nouvelle pratique chirurgical illustree. Paris: G. Doin et Cie., 1952, vol. 6, pp. 237-265.
8. Weckesser, E. C.: Plication of Small Intestine for Obstruction Due to Adhesions, Noble Procedure, Arch. Surg. **65**:487-497, 1952.
9. Lord, J.: A Critical Evaluation of the Noble Plication Procedure in the Management of Chronic Recurrent Intestinal Obstructions Due to Adhesions, Gastroenterol. **19**:801-810, 1951.
10. Noble,[6] p. 203.
11. Noble,[6] pp. 71-74.
12. Noble,[6] pp. 123 and 124.
13. Thomeret, G.: Personal communication.
14. Noble[6], pp. 141-204.
15. Hertzler, A. E.: The Peritoneum. St. Louis: The C. V. Mosby Company, 1919, vol. 1, pp. 238-276.
16. Noble,[6] pp. 57-91. Noble.[4c] Devine, J. W. Jr.: New Tube for Use in Treatment of Intestinal Obstruction, J.A.M.A. **148**:115-116, 1952. Killins, J. A., and Claggett, O. T.: Recurrent Intussusception Among Infants: Report of a Case, Proc. Staff Meet. Mayo Clinic **16**:329-331, 1941.
17. Noble.[2] Noble.[4a] Noble.[5] Noble[6]
17. Noble.[2] Noble.[4a] Noble.[5] Noble.[6]
18. Noble,[6] pp. 174, 177 and 178.
19. Smith, R. S.: Plication Operation in Treatment of Small Bowel Obstruction, Northwest Med. **50**:765-768, 1951.
20. Donaldson, J. K., and Cameron, R. R.: A Study of the Use of Silk, Catgut and the Noble Plication with Reference to Abdominal Adhesions, Surgery **5**:511-521, 1939.
21. Ripstein, C. B.; McDougall, H. A., and Thompson, A. G.: The Plication Operation of the Treatment of Peritoneal Adhesions, Canad. M.A.J. **63**:43-46, 1950. Teason, J.: A Rare Anomaly in Peritonitis Involving the Small Bowel, J. Internat. Coll. Surgeons **17**:1952. Seabrook, D.: Chronic and Recurrent Intestinal Obstruction, West. J. Surg., Obst. & Gynec. **57**:630-636, 1949. Lord.[9] Lord, J.: Howes, E. L., and Jolliffe, N.: Surgical Management of Chronic Recurrent Intestinal Obstruction Due to Adhesions, Ann. Surg. **120**:315-322, 1949.

An obstinate man does not hold opinions, but they hold him.

—*Butler*

A narrow mind begets obstinacy; we do not easily believe what we cannot see.

—*Dryden*

None so blind as those that will not see.

—*Henry*

The mind of the bigot is like the pupil of the eye; the more light you pour upon it, the more it will contract.

—*Holmes*

The Plastic Flap in Closure of the Pilonidal Cyst Excision Defect

Experience with Twenty-Five Cases

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THIS paper is the result of an effort to find an easier and simpler solution to the problem of the pilonidal cyst and sinus excision defect — a solution that might take a little longer at the operating table but would require less preoperative and postoperative care, and would permit early ambulation, fewer dressings and earlier return to work with a closed, well healed operative site.

The wealth of material published with regard to the treatment of the pilonidal cyst and sinus is ample evidence that as yet no definite technics either closed or open, has been entirely satisfactory.

The problem is not complete excision of the tract, as this is essential to any successful procedure. It resolves itself into either healing of the excisional area by granulation or by primary closure.

1. *Simple Excision and Granulation.*—This is the basic procedure, which has been evaluated from the standpoint of hospital stay and especially of low percentage of recurrences in a comprehensive survey by Rogers of the Massachusetts General Hospital and others.

The objection of both surgeon and patient is the length of time required for the granulation process to fill in the defect and epithelize. While an average of fourteen and four-tenths weeks is reported, there are many cases in which months and even a year may ensue before complete healing takes place.

Even then, the epithelial covering is so thin that it is easily traumatized and reopened for an additional period of dressings. This is in spite of excellent cooperation by the patient and the use of all the suggested methods of promoting wound healing.

Granulation is really expensive to the patient, and the prolonged dressings are a nuisance to both him and the surgeon. The good things about it are that the resultant scar is not particularly disfiguring and the percentage of recurrence relatively low.

2. *Excision and Partial Primary Closure.*—This method consists of undercutting the edge of the skin after excision of the cyst and suturing this edge to the presacral fascia, leaving a granulating area over the sacrum to epithelize later or be treated with a skin graft. This is a compromise between the open and closed methods and an effort to salvage as much as possible of the advantages of both. It is still granulation, however, and requires considerable care to avoid the entire area opening when the cutaneous sutures slough out or are removed.

3. *Excision and Primary Closure of the Defect.*—This method covers a variety of technics. Many of these were devised in Army and Navy Hospitals during World War II, in an effort to speed up convalescence and early return to duty.

Essentially it consists of using bi-elliptic incisions for removal of the cyst and sinus tracts and closure in several layers with suture material varying from catgut to stainless steel wire. With these methods one should take as little skin as possible and undercut the edges either by making the

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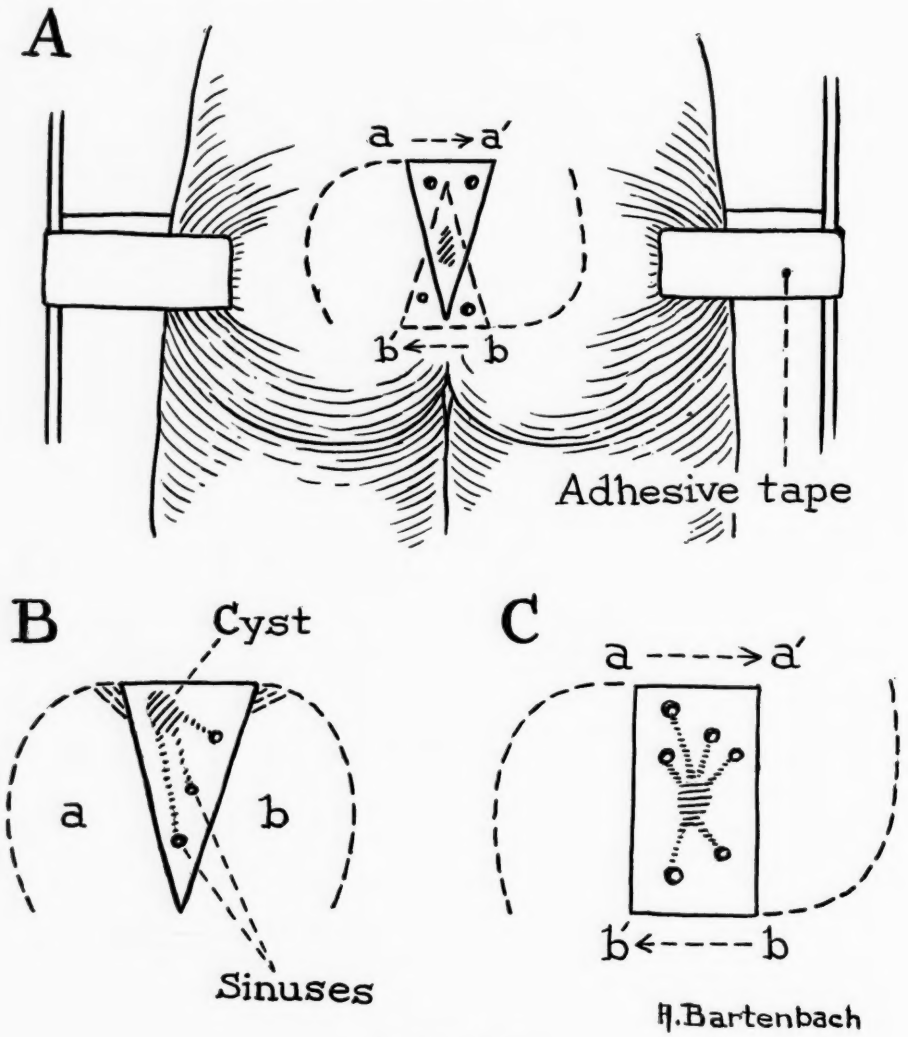

Fig. 1 (see text).

walls wedge-shaped or by deliberately incising the subcutaneous tissue. Pope has suggested mobilization of the gluteus maximus muscle to assist in this closure. He has reported a high percentage of successful results.

Although primary closure by any of these methods is excellent when it is successful, it necessitates extremely careful technics, prolonged hospitalization both preoperatively and postoperatively, and exceptional postoperative care to prevent the entire wound from breaking open and reverting to healing by granulation.

It is hardly possible to close this defect without tension on the sutures, a primary requisite to good healing, as well as eliminate the dead space beneath. This fact is

well evidenced by the type of sutures used —either heavy, nonabsorbable material or vitallium wire. Then too, failure, no matter how infrequent, results in complete opening of the wound with the aforementioned prolonged healing by granulation.

4. *Closure by Full Thickness Double-Ended Skin Flap* (Lahey Technic).—This is a highly successful method but which leaves the problem of the defect in the

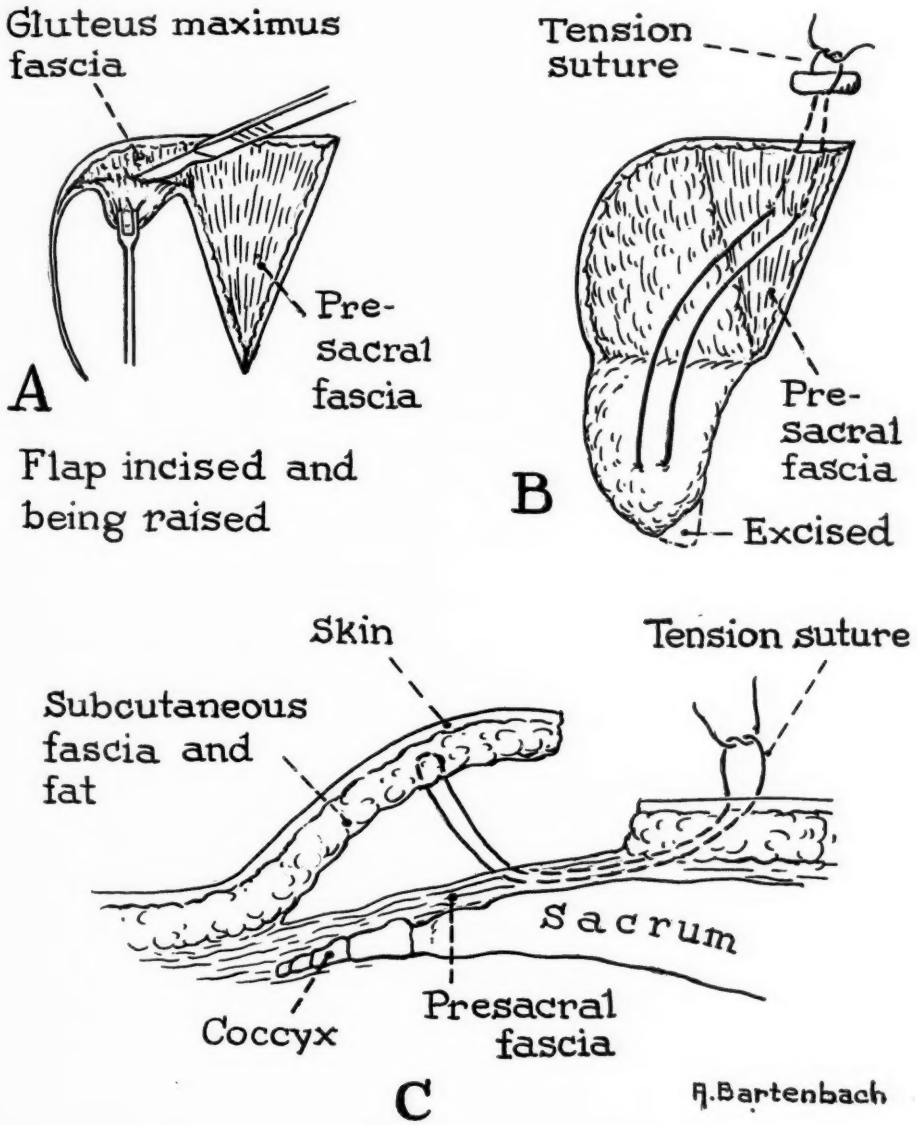

Fig. 2 (see text).

buttock—this either must be skin grafted or allowed to granulate with a resultant wide buttock scar.

5. *Closure by the Broad-Based Pedicle Flap.*—This method uses the full thickness of skin and superficial tissue. The graft is not new in this area, having been used with remarkable success in the closure of decubitus ulcers in paraplegic patients; there can be no greater test of its stability. A good firm closure in such a patient must insure an even better closure in a patient not suffering the trophic disorders of damage to the spinal cord.

It is a versatile method, in that the flap can be swung from a caudad or cephalad base or, in rectangular defects, from both. In long thin triangular defects its curve may start at any point on either leg that appears to fit the circumstances of the case, with good expectation of success.

It is relatively safe—with the observation of a few cardinal points the danger of slough or complications should be minimal.

This method has been used in 25 cases over a period of seven years and has been so successful therein that, although the series is small, this report seemed indicated. There has been but 1 semifailure, and only 2 minor recurrences have been encountered, which were treated by a similar technique.

Preparation of the Patient.—Acute Conditions: When a fulminating infection is present the treatment of choice is sitz baths, penicillin administered parenterally and incision and drainage when indicated until the acute process subsides. With this therapy, upward of one week may be all that is necessary.

Subacute or Chronic Conditions: The patient is admitted to the hospital on the day prior to operation, and sitz baths with tincture of green soap solutions are ordered for the night before and the morning of operation.

Adequate preparation of the skin is also ordered, a wide area of both buttocks and perineum being shaved. Pencillin, 400,000 units, is given intramuscularly. The question of adequate serum protein levels, vitamins and hydration should be no problem, as the majority of the patients are young and healthy. Blood or fluids at the time of operation may be necessary and should be prepared.

Operative Procedure.—Step 1: The patient is placed in the prone position with the buttocks elevated and controlled either by adhesive tape or by weighted wire hooks.

The operative area is scrubbed with soap and water, after which ether and a skin antiseptic, such as tincture of merthiolate, are applied.

Excision is made in a triangular fashion (instead of the usual semi-elliptical technic) down to the presacral fascia. This is done because the sinus tract usually extends to one side or the other into the buttock and either anteriorly or posteriorly.

The base of the triangle may be either caudad or cephalad, depending on the site of the tract. The excised area is then examined to be sure the total pathologic portion has been removed, and all bleeding points carefully controlled.

Step 2: From the base of the excised triangle a curved incision is made; this line is continued around so that a broad-based flap is formed and freed upward from the gluteus maximus fascia. All bleeding points are again controlled, and the flap is brought over the denuded area.

It is essential that an *adequate* base be allowed in order to nourish this flap. It should be marked out in advance of actual incision by scratching or with a skin pencil. It should be roughly equal to the width of the original triangle excision base. This is to insure that no sloughing will occur at the apex of the flap since this would delay healing.

A small triangular area is next removed from the apex of the new flap, because it has been observed that the circulation of this area is usually questionable and may cause a minor slough if the tissue is not excised.

Step 3: The previously applied adhesive or wire traction is now removed and the flap anchored to the presacral fascia by a single through suture tied over a gauze

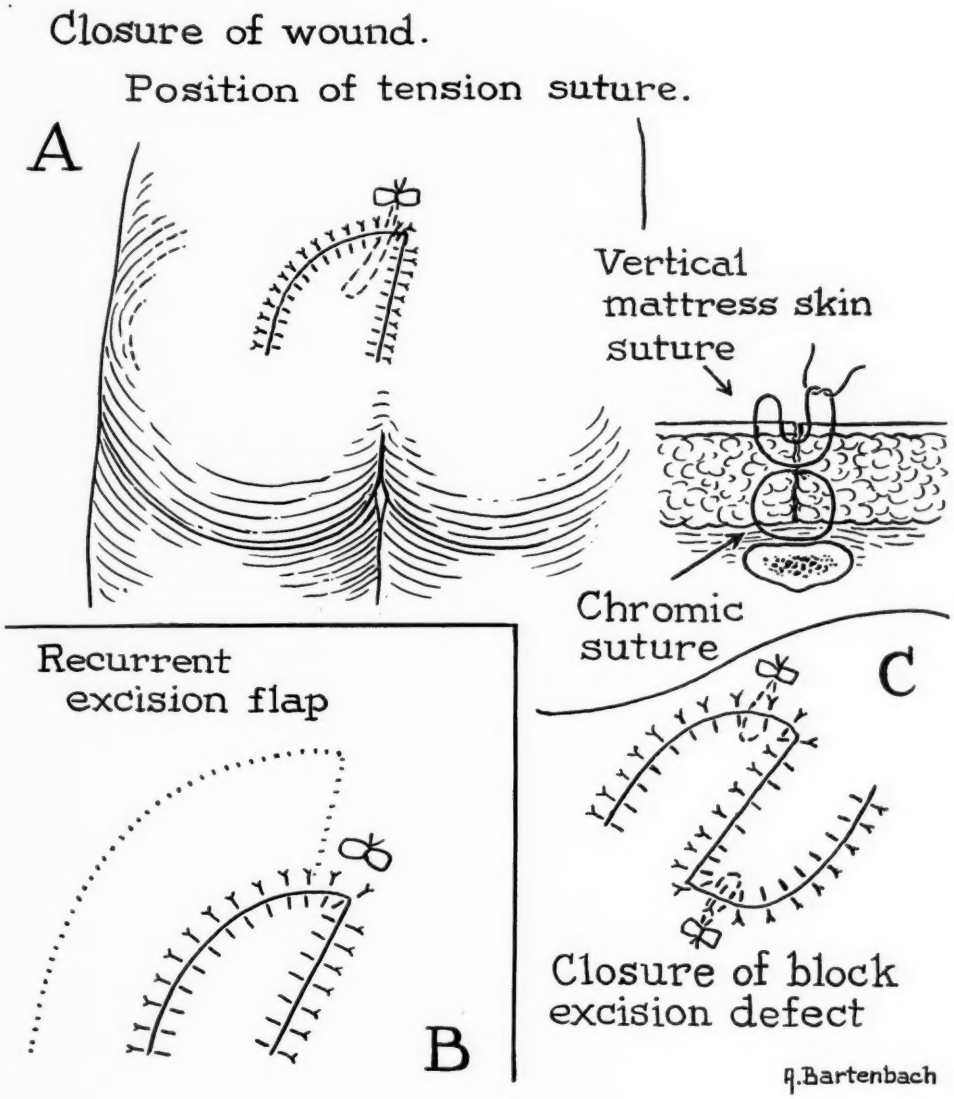

Fig. 3 (see text).

buffer. This suture is started outside the wound area, above the original triangular base. It is carried down through the presacral fascia, brought up through the undersurface of the flap sufficiently to provide a good purchase, then carried back through the sacral fascia and out again close to the starting point.

The gauze buffer is tied here in order to eliminate the dead space without interfering with the nutrition of the skin at the apex of the flap.

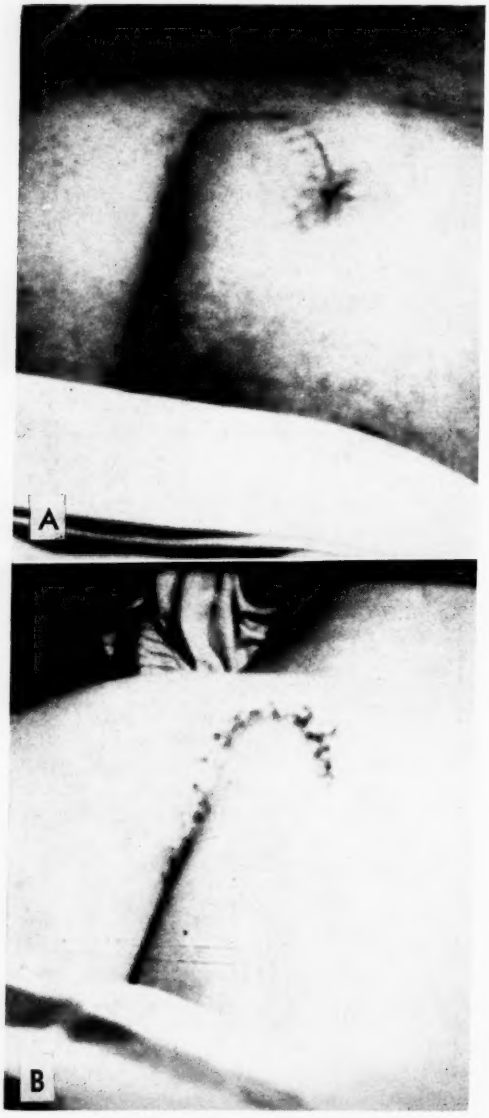

Fig. 4 (see text).

Step 4: The wound edges are sutured by a two-layer technic with interrupted No. 0 chromic catgut in the fat and subcutaneous tissue and interrupted cotton or silk in the skin. These skin sutures should be of the vertical mattress type and placed meticulously, so that good approximation and primary healing will take place with little or no tension on any one suture. This also prevents tiny epithelial invaginations with ingrown hair, whch may cause recurrences.

A voluminous dressing is applied, with adhesive strapping of the buttocks in the usual manner.

After-Care.—The flap is observed on the following day and the dressing changed daily to be sure that adequate circulation is present. If there is any question, the gauze pad is cut from the tension suture.

Procaine pencillin, 400,000 units, is given daily. The bowels may be controlled by low residue diet until the second day.

On the third day the tension suture is removed; an enema may be given; the patient is given a "house diet" and is allowed to go to the bathroom. On the fifth day he is discharged home, the remaining sutures to be removed on the seventh to the tenth day at the office. Usually at this time the flap is well healed, and he can return to his usual occupation in four to five weeks.

Possible Complications.—1. *Serous Accumulation Beneath the Flap:* This can be removed by the insertion of a large caliber (size 16) needle and syringe without disturbing the wound sutures and without danger to the flap itself.

2. *Slough:* This danger should be minimal provided a few cardinal points are kept in mind:

a. The base of the flap should be estimated and its extent marked. It should be as wide as the base of the defect.

b. The incision should be full thickness and down *to* but not *through* the gluteus maximus fascia.

c. All incisions should be made straight, without undercutting of the edges, if possible.

d. Buttons or other sources of pressure on the flap should not be used to eliminate dead space or for any other reason, as the circulation distal to this pressure will be interfered with and will slough.

3. *Infection.*—This is not a serious prob-

lem as a rule if adequate preoperative preparation is done and hemostasis during the operation is observed. If infection occurs, it is controlled by hot compresses and the antibiotics. It should not seriously affect the healing time.

4. *Spitting out of Deep Nonabsorbable Sutures.*—This was rather a nuisance in the first few cases, until it was found that chromic catgut in the subcutaneous fascia was just as suitable and obviated the formation of foreign body blebs and extrusion of the cotton or silk for months after the wound was apparently well healed.

Recurrence.—There were 2 so-called recurrences in this series, extending over a period of seven years. Both were treated as was the original cyst except that the area was much smaller. Both patients were hirsute, obese long-distance truck drivers. It was the impression that the constant irritation caused by the leather seat, perspiration and poor hygiene were instrumental in these recurrences. These were about the size of the terminal phalanx of one's little finger, had a chronic granulomatous appearance. They were easily excised and reflapped with, in 1 case, only three weeks' work loss. The treatment is shown in Figure 3*B*. In 22 cases full healing took less than six weeks, and in 18 healing occurred in four weeks. In 1 early case a slough of about one-third of the flap was caused by the use of a button; this necessitated a healing time of fourteen weeks, with small pinch grafts applied in the office for final closure of the area. The two recurrences were treated by swinging a small flap, with equal success.

From this series, it is my conviction that the use of a broad-based flap is a highly successful method of closure and offers minimal possibility of prolonged complications, as compared with any of the previous forms of treatment.

SUMMARY

A plastic flap technic for closure of the defect resulting from excision of the pilonidal cyst and sinus is described, with a seven-year follow-up. The method presents the following advantages:

1. A healing time of four to six weeks can be expected.
2. Only a short period of hospitalization is required.
3. It relieves the surgeon of multiple dressings and prolonged after-care, and the patient of prolonged absence from work.
4. The flap graft covers the sacrum with a good cushion that is unlikely to cause subsequent tenderness or reopening of the wound.
5. Even if there is some sloughing of the apex through unfortunate circumstances, the healing time is not seriously prolonged, as cutaneous tension is relieved by the remainder of the flap.

RÉSUMÉ

Une technique de greffe plastique pour combler le défect résultant de l'opération d'un kyste dermoïde et d'une fistule au neveu du rectum est décrite, avec un recul de sept ans. La méthode présente les avantages suivants:

1. Guérison obtenue dans un délai de 4 à 6 semaines.
2. Temps d'hospitalisation court.
3. Elle évite de multiples pansements et des soins post-opératoires prolongés; elle permet au malade de reprendre son travail rapidement.
4. Le sacrum est recouvert d'une greffe

Fig. 5 (see text).

bien étoffée, de telle façon que ce dernier reste insensible et ne fistulise pas.

5. Même s'il se forme une escarre, le temps de guérison n'est pas sérieusement prolongé, puisqu'il n'y a pas de tension cutanée.

ZUSAMMENFASSUNG

Zur Schliessung des nach Exzision einer pilonidalen Zyste oder Fistel entstehenden Defekts wird die Technik einer Lappenplastik und ihre Resultate nach sieben Jahren beschrieben. Das Verfahren bietet die folgenden Vorteile:

1. Heilung kann innerhalb von vier bis sechs Wochen erwartet werden.

2. Der erforderliche Krankenhausaufenthalt ist kurz.

3. Das Verfahren erspart dem Chirurgen häufigen Verbandwechsel und langdauernde Nachbehandlung und ermöglicht dem Kranken eine rasche Wiederherstellung der Arbeitsfähigkeit.

4. Die Lappenplastik deckt das Kreuzbein mit einer guten Polsterung, die eine spätere Empfindlichkeit oder ein Aufbrechen der Wunde unwahrscheinlich macht.

5. Selbst wenn es durch ungünstige Verhältnisse zur Abstossung der Spitze des Lappens kommt, verlängert sich die Heilungszeit nicht wesentch, da die Hautspannung durch den Rest des Lappens gemildert wird.

RESUMEN

Se describe una técnica de colgajo para el cierre de un defecto resultante de la extirpación de un quiste pilonidal, con una observación de siete años. El método tiene las siguientes ventajas:

1. Un tiempo de cicatrización de cuatro a seis semanas.

2. Se requiere unicamente un período corto de hospitalización.

3. No requiere apósitos múltiples ni cuidados prolongados del cirujano y el paciente no se aparta largo tiempo de su trabajo.

4. El colgajo cutáneo cubre el sacro con buen acojinamiento que es díficil produzca dolor ó reapertura de la herida.

5. Aun cuando en circunstancias desafortunadas haya alguna necrosis en la punta del colgajo, el tiempo de cicatrización no se retarda grandemente, ya que la tensión cutánea es disminuída por el resto del colgajo.

RIASSUNTO

Viene descritto un metodo di plastica a lembo per la cura delle perdite disostanza consecutive ad asportazione di cisti e fistole sacro-coccigee, controllato fino a 7 anni di distanza. I vantaggi sono i seguenti:

1. Consente la guarigione in un periodo di 4-6 settimane.

2. Richiede una ospedalizzazione di breve durata.

3. Risparmia molte medicazioni e cure post-operatorie e consente una precoce ripresa del lavoro.

4. Il trapianto copre il sacro con un discreto spessore di tessuti che prevengono i dolori e la riapertura della ferita.

5. Anche se vi è una piccola necrosi per circostanze sfavorevoli, il periodo richiesto per la guarigione non è lungo, dacchè il lembo restante impedisce la tensione della cute.

BIBLIOGRAPHY

Hamilton, J. D., and Cattanach, L. M.: Comparative Study of Chemotherapies in the Surgery of Pilonidal Sinus, Am. J. Surg. **74**:449, 1947.

Swenson, S. A. J.; Hackins, H. N., and Groesbech, H. P.: Pilonidal Sinus, Am. J. Surg. **66**:49, 1944.

Kooistra, H. P.: Pilonidal Sinuses, Am. J. Surg. **55**:3-17, 1942.

Rogers, H.: Pilonidal Sinus, Surg., Gynec. & Obst. **54**:803-810, 1933.

Pope, C. E., and Hudson, H. W.: Pilonidal Sinus: Review of 130 Consecutive Cases with Closure, Arch. Surg. **52**:690-700, 1946.

Pope, C. E.: New and Successful Closed Operative Procedure for Pilonidal Sinus—Gluteus Maximus Mobilization, Arch. Surg. **52**:701-712, 1939.

Holman, E.: Pilonidal Sinus — Treatment by Primary Closure, Surg. Gynec. & Obst. **83**:94-100, 1946.

Rosser, C., and Kerr, J.: Pilonidal Management —Present Status, J.A.M.A. **133**:1003-1007, 1947.

Kleiman, A.: Pilonidal Cyst: A Comparison of

Surgical Treatments, Surgery 28:851-856, 1950.

Pilonidal Cyst; Treatment by Uniformly Successful Method, J. Internat. Coll. Surgeons 13:334-337, 1950.

Haberson, J. C., and Brintwell, E. S.: Surgical Principles in the Treatment of Pilonidal Cyst and Complications, Am. J. Surg. 79:101-109, 1950.

MacFee, W. F.: Pilonidal Cysts and Sinuses: A Method of Wound Closure, Ann. Surg. 116:687, 1942.

Pilonidal Cyst; Review of New Procedure for Operation and Treatment, Am. J. Surg. 59:18-24, 1943.

Boger, E. V., and Pinkham, E. W. Jr.: Primary Split Skin Graft in the Treatment of Pilonidal Cysts, U. S. Armed Forces M. J. 2:1733-1736, 1951.

Russell, G.: A Method of Excision and Primary Closure of Pilonidal Cysts and Sinuses, Canad. M.A.J. 6:267-270, 1949.

To suspect a friend is worse than to be deceived by him.

—La Rochefoucauld

Every man should keep a fair-sized cemetery in which to bury the faults of his friends.

—Beecher

Friendship consists in forgetting what one gives, and remembering what one receives.

—Dumas the Younger

When friendships are real, they are not glass threads or frost work, but the solidest things we can know.

—Emerson

So long as we love we serve; so long as we are loved by others I would almost say that we are indispensable; and no man is useless while he has a friend.

—Stevenson

That friendship will not continue to the end which is begun for an end.

—Quarles

Friendship is a creature formed for a companionship, not for a herd.

—Montaigne

Friendship is the only cement that will ever hold the world together.

—Wilson

Status of Extrapleural Pneumothorax

Clinical Analysis of 150 Cases of Pulmonary Tuberculosis

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ISTANBUL, TURKEY

THIS report is based on the great interest in extrapleural pneumothorax at the Tuberculosis Hospital in Istanbul and the high level of efficiency achieved in its performance. I shall present the details and results of 150 such operations performed in this clinic in a serial investigation begun three years prior to the time of writing. The procedure is still favored here because of its reversibility and its selectivity.

In spite of the limited classic indications, I have been accustomed to operate on almost all patients not suitable for thoracoplasty and on those in whose cases pneumothorax had failed. In a great many cases sufficient improvement was obtained, thus fortifying my personal opinion that this operation is an excellent temporary collapse measure.

It is important to mention here that in the period between 1933 and 1935, in Prof. Nissen's clinic at the University of Instanbul, pneumolysis was also made the subject of systematic analysis, but experience was then still limited, and no large series were available to justify any conclusions as to the value of the procedure.

In analyzing the cases of 150 patients on whom I have operated, I must point out that the end results have not yet been obtained and that the time lapse is not sufficient to enable me to arrive at any definite conclusion or to formulate any sweeping statement. On the basis of the number of operations performed, however, I have a clear idea of the efficiency and selectivity of the technic and of its overall value. All the good results I have obtained are due to efficient cooperation between the surgical staff and the internists.

My first case was reported on May 19, 1949, and was, to the best of my knowledge, the first such case to be reported in Turkey. The patient, a woman, left the hospital improved but was not followed up. The second patient, fortunately, is still under observation. She was given every advantage of this classic treatment and is considered clinically cured.

After the apparently successful result in this second case, physicians were impressed by the method and the principles underlying it. The prolonged postoperative care, however, as well as the complications observed, frightened them and so limited its use. This fear was of great help to me, since it obliged me to improve my technic. With more intelligent selection of the patients, the results showed an improvement so consistently increasing that the negative attitude vanished.

In evaluating the results one must consider the various indications. In this series the pulmonary lesions varied from unilateral and isolated to bilateral and extensive. Of course, the results were not the same. This difference compelled a more careful selection of the patients.

The success of the method depends on certain principles and the achievement of certain goals. It is not merely a matter of careful operating; to be adjudged successful, the operation must be followed by well-planned postoperative supervision. Here the treatment is divided into two stages. Each stage has its importance as well as its complications. I accept the result as successful only if the postopera-

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Fig. 1 (Case 1).—Miss L. G., aged 25. *A*, unilateral cavitary lesion, about one year old, located at upper part of right side. *B*, tomographic film in same case. *C*, film taken after operation on May 16, 1940. Cavity appears closed. Sputum normal. Patient considered cured. (Roentgenograms reversed; read left for right and vice versa.)

tive period, after a selective and sufficient collapse, is tolerated without complications. Postoperative care here depends on the social position and income of the patient; in my opinion, if this interferes so as to prevent the patient from remaining under prolonged supervision it may be wiser to avoid the whole treatment. Also, the physician in charge must have some knowledge of the operation and a practice of some duration in a surgical clinic. As a matter of fact, to make sure of adequate postoperative supervision, I prefer to operate on urban patients, since patients who come from the middle country seldom do well. They always leave the medical center early, and, away from adequate care, they often become subject to severe complications and return in worse condition than before. Many of these I have been unable to follow up.

Next to the social difficulty comes the pathologic character of the lesion. For small, limited new lesions situated in the upper part of the lung, a selective pneumolysis may be better tolerated than would an extensive extrapleural procedure. I have succeeded in persuading our phthisiologists to accept this important principle. In cases of bilateral tuberculosis, on the other hand, if the vital capacity is insufficient for an extensive collapse, the latter method is the treatment of choice, because of its selectivity.

In the presence of a limited lesion, even with an adhesive pleura, one must not forget that the mediastinum may be labile and so may yield to the pressure obtained. The surgeon cannot always guarantee the volume of the space opened; also, after operation, the space may grow wider because of changes in the rhythm and tension of respiratory movements and also under the pressure of the liquid taken in. Owing to this increase in the space, mediastinal deviations may take place. I have not encountered "flutters" like those observed after plastic procedures. The surgeon may sometimes be surprised to find, in later controls, a space as wide as that referable to the intrapleural pneumothorax. With a dyspneic patient, after a short period, one must keep this complication in mind.

When large, thick-walled and fibrotic cavities are present and there is heavy infiltration of the surrounding tissue the results are always poor. In most such cases, separation of the pleural from the fascia demands great skill and cannot be done within the limits of safety, nor will the collapse be established in the manner desired. Many complications, therefore, are likely to occur. During the postoperative period one can see the cavity at the base of the space unchanged, or rather deformed. The clinical signs may be altered, but the sputum continues to give a positive reaction for Koch's bacillus. Under these circumstances, continued insufflations are valueless and create an unfavorable opinion of the procedure.

When my associates and I applied the treatment to patients with partial pneu-

mothorax we observed that the physicians delivered these patients to the surgical clinic after a long period of insufflations. Of course, the time that had elapsed was sufficient to thicken the pleural fascia. The thickened pleura always loses its elasticity and is likely to be torn or punctured by negative pressure during the operation. In the second stage, with the resulting tear present, high pressure cannot be maintained in the open space; also, the thickened pleura does not yield properly to pressure, and therefore the desired collapse may not be obtained even by subsequent reinflations. In such a case, if the pneumothorax was indicated for a lesion situated in the upper lung field, we advise the treating physician to abandon it before sending the patient to be operated on. In some patients with extensive lesions one may try to combine the two spaces by means of a wide incision. My experience does not lead me to favor the last-mentioned method. The negative pressure of the intrapleural space always neutralizes the positive pressure one desires to produce by reinflation. Then the newly separated parietal pleura, under this influence and because of the alternate expansion, readheres to the fascia, which results in closure of the extrapleural space.

In cases of bilateral disease the opposite lung must be taken under control by pneumothorax. One is not always able to control the other side, because extensive pleuritis may make it impossible. Without this control, however, the surgeon cannot be optimistic about the operative results.

From the foregoing observations one may conclude that the success of the treatment depends to a great extent on the accuracy of the range of indications. With my growing experience I was obliged to alter this range. To the condition of the lesion, its volume, extent, duration, anatomicopathologic character and position I began to add the social and economic status of the patient, his place of residence, his or her sex (I prefer the female for this procedure), and his age (children and old persons are preferable) as relative indications. The range of indications, therefore, may be summarized as follows:

1. New infections with thin-walled cavities measuring less than 4 by 4 cm.
2. Fibrotic cavities measuring less than 4 by 4 cm.
3. New infections with cavities measuring more than 4 by 4 cm.

As I widened the range I also operated on

4. Patients with fibrotic cavities measuring more than 4 by 4 cm.
5. Patients with unilateral extensive caseopneumonic lesions.
6. Patients with bilateral infection.

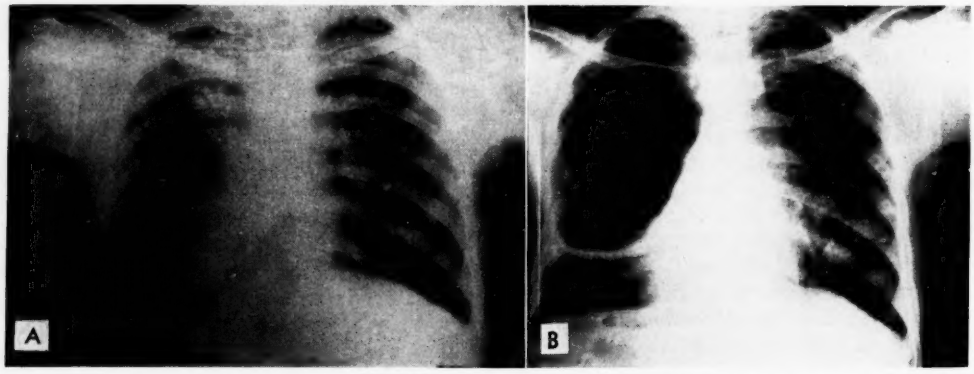

Fig. 2 (Case 2).—Mr. N. S., aged 22. *A*, fibrotic old cavitary tuberculous lesion at left upper lobe. *B*, same patient. After apicolysis and pneumothorax a satisfactory air chamber was obtained. Sputum normal. (Roentgenograms reversed; read left for right and vice versa.)

7. Patients with giant cavities (especially if in the upper lung field).

To prepare the patient for operation, I generally give him shots of streptomycin, 0.5 Gm. daily for three days. This I consider a worth-while procedure to prevent dissemination.

Toxic patients with anemia and in bad general condition are given blood transfusions before and during the operation. All of them react favorably.

I prefer to operate with the patient under general anesthesia. I performed 100 operations with nitrous oxide–oxygen, 35 with kemital-sodium and 14 with a combination of the two. All were satisfactory, and I did not encounter any disadvantage.

I prefer a short incision in the paravertebral space. In 2 cases I made it by the anterior approach, following the direction of the fourth rib, but found it disadvantageous for pneumolysis. Although the point of entry depends on the location of the lesion, in a great number of cases I resected the fourth rib and, rarely, the sixth. In 6 cases, instead of resecting, I entered through the fifth intercostal space and found it remarkably advantageous. In fact, this approach shortened the operating time, and all operations in which I employed it were performed as easily as with resection.

Before closure I injected a solution, here called streptocillin which contains 1 Gm. of streptomycin and 1,000,000 units of penicillin, into the space. At first I thought it advisable to drain the space, and in 3 cases used elastic tubes. Even when I left them not more than forty-eight hours they did not prevent the occurrence of complications, so I discontinued drainage. To check postoperative bleeding I used locally, in 1 group of cases, such hemostatic preparations as topostassine, coagulene, serum or gelatin, but no significant effect was observed.

Postoperatively I employed (1) blood transfusions when required for excessive bleeding; (2) penicillin therapy for two or three days; (3) aspiration (on the third day) of the sanguineous liquid accumulated in the space, with initiation of insufflations, and (4) injections of streptocillin directly into the space. Aspiration of the liquid must be done methodically, or the fluid may coagulate and even organize, leaving a narrow and valueless space (Sevim Ajur).

The age and sex incidence of the series of 150 patients, 95 male and 55 female, may be tabulated as follows:

Age, years	14-20	21-30	31-40	41-50
No. of patients	37	76	25	12

Pathologically the lesions were classified thus:

Small new cavity	15
Small fibrotic cavity	60
Large fibrotic cavity	75

Twenty-four patients had bilateral le-

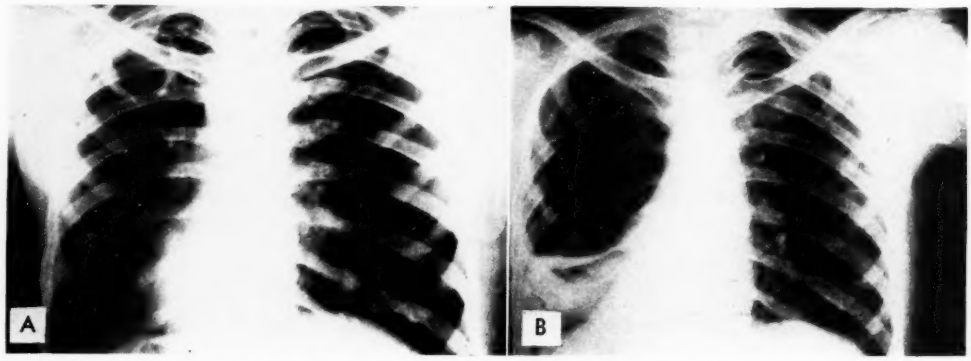

Fig. 3 (Case 3).—Mr. H. A., aged 25. *A*, left solitary fibrotic-walled apical cavity. *B*, same, after extrapleural apicolysis and pneumothorax. Very large separation made and complete collapse obtained. (Roentgenograms reversed; read left for right and vice versa.)

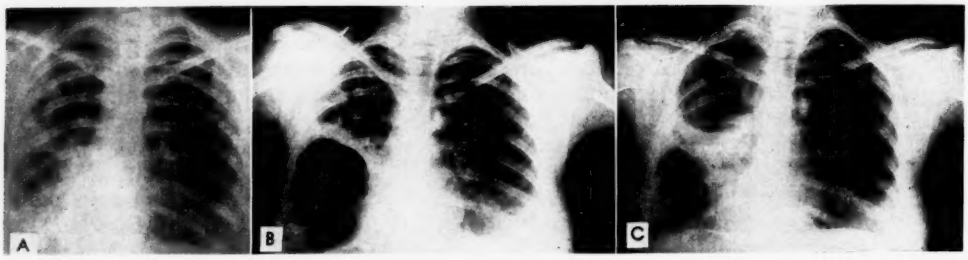

Fig. 4 (Case 4).—Miss B. E., aged 20. *A*, early cavitary tuberculosis of left upper lobe. *B*, film taken after pneumothorax, which failed. Cavity is still visible on the air pocket. *C*, after operation. Cavity has been collapsed by combination of extrapneumothorax and intrapneumothorax. (Roentgenograms reversed; read left for right and vice versa.)

sions. In 5 of them pneumothorax had been established previously on the opposite side. In the remaining 19 the localized and even the extensive lesions were uncontrolled. In 22 patients with partial pneumothorax which had had no effect on the lesion of the upper lung field I combined the two spaces. I was able to maintain the two spaces in 3. In the remainder the extrapleural space was sufficient for collapse and, relying on this effect, I discontinued the intrapleural pneumothorax. My opinion is that it is nonsense to insist on continuing the collapse of healthy portions of the lung.

Finally, to make an adequate analysis of the operations, I classified them, as regards indications, into two groups. The first group consisted of 75 cases in which isolated cavities (new or fibrotic) were situated in the upper portion of the lung. Each of the patients in this group underwent classic extrapleural pneumolysis. In postoperative controls the diseased portion of the lung was observed to be thoroughly collapsed. Complications had not occurred, and the bloody fluid that accumulated had disappeared after a few aspirations. In some cases no fluid accumulates (Sayim Oz; Aycha Kirtulan).

All of the patients left the hospital in less than one month. The sputum of 9 patients continued to give positive results. In 5 of these the disease was bilateral, and after the same operation had been performed on the opposite side the reaction of the sputum became negative. In the 4 others, who had unilateral disease, the lesions were observed again after a short period, and I was obliged later to perform thoracoplasty on 3 of them (1 refused). The bacilli disappeared subsequently. After six months 1 of these patients returned with a new extensive lesion of the caseous pneumonic type in the opposite lung and died of profuse hemoptysis To draw an accurate picture of the results, 89 per cent of the patients

Fig. 5 (Case 5).—Miss S. C., aged 30. *A*, left upper lobe showing old cavitary tuberculosis. *B*, pneumothorax was begun and failed. *C*, satisfactory collapse after apicolysis and pneumothorax obtained by combined extrapleural pneumothorax and intrapleural pneumothorax. (Roentgenograms reversed; read left for right and vice versa.)

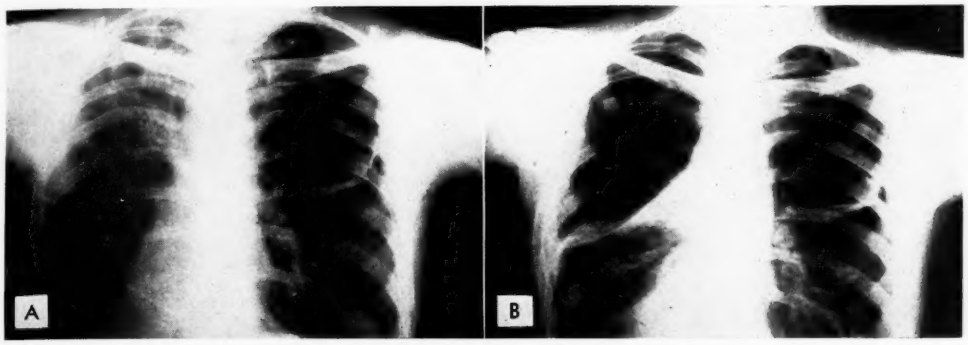

Fig. 6 (Case 6).—D. G., aged 30. *A*, bilateral fibrocaseose lesion. Right side under pneumothorax treatment. Pneumothorax was attempted on left side, but failed. *B*, left extrapleural apicolysis performed and satisfactory collapse obtained. (Roentgenograms reversed; read left for right and vice versa.)

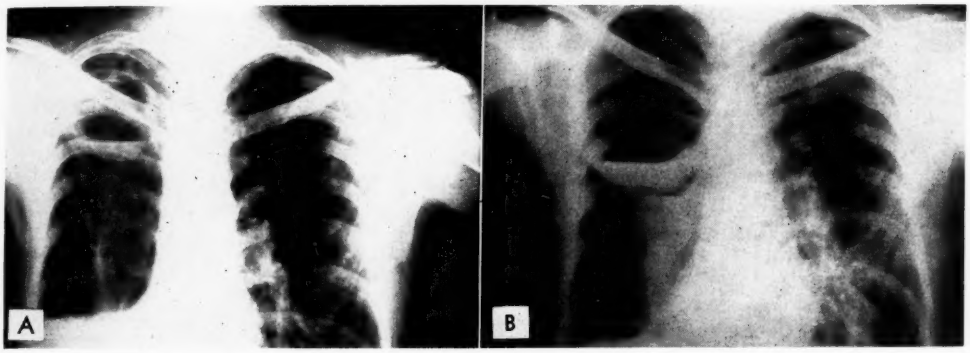

Fig. 7 (Case 7).—Mr. K. V., aged 32. *A*, large fibrotic walled cavity in left upper lobe, with ineffective pneumothorax. *B*, satisfactory collapse obtained after apicolysis and pneumothorax. (Roentgenograms reversed; read left for right and vice versa.)

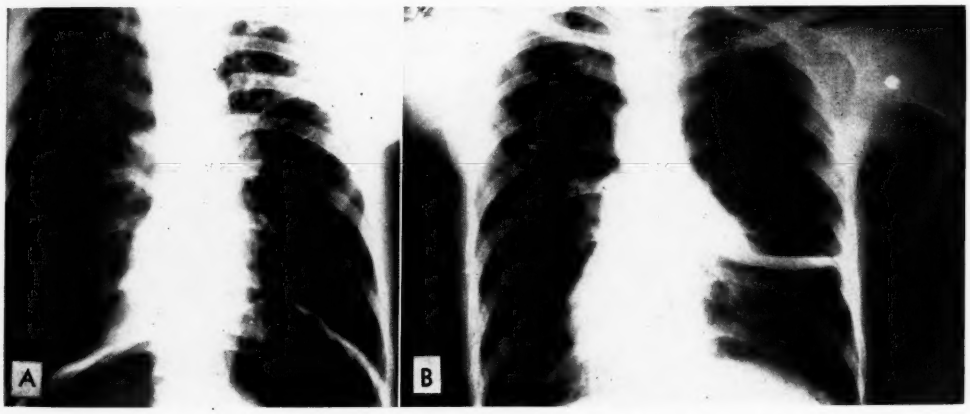

Fig. 8 (Case 8).—Mr. M. E. *A*, old cavity on right side, located close to periphery. *B*, film taken after operation. Very large separation made and good result obtained. Separation made without any rib resection. (Roentgenograms reversed; read left for right and vice versa.)

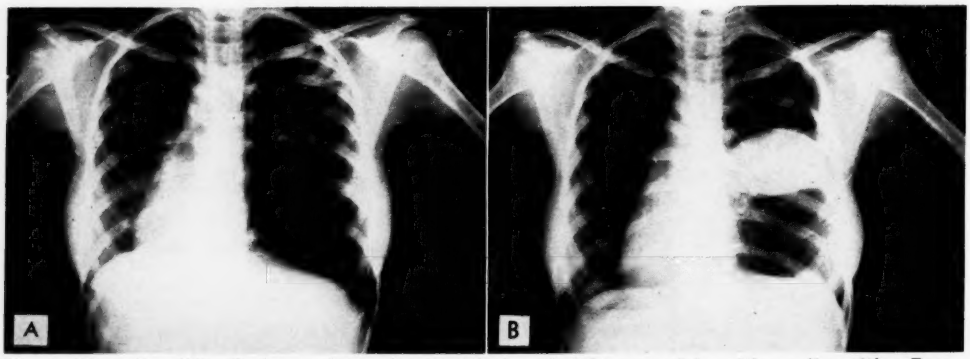

Fig. 9 (Case 9).—Miss S. A., aged 16. *A*, recent lesion of right upper lobe with small cavities. Pneumothorax was attempted but failed. Many adhesions prevented collapse. *B*, good collapse obtained after extrapleural apicolysis and pneumothorax. Fibrinous accumulation is visible in bottom of chamber. (Roentgenograms reversed; read left for right and vice versa.)

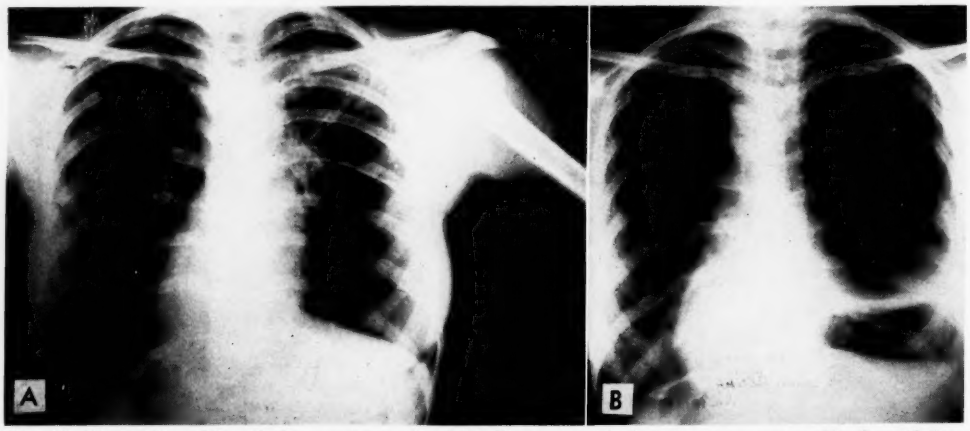

Fig. 10 (Case 10).—Miss S. O., aged 20. *A*, right fibrocaseose lesion about one year old. *B*, satisfactory collapse obtained after extrapleural apicolysis and pneumothorax. (Roentgenograms reversed; read left for right and vice versa.)

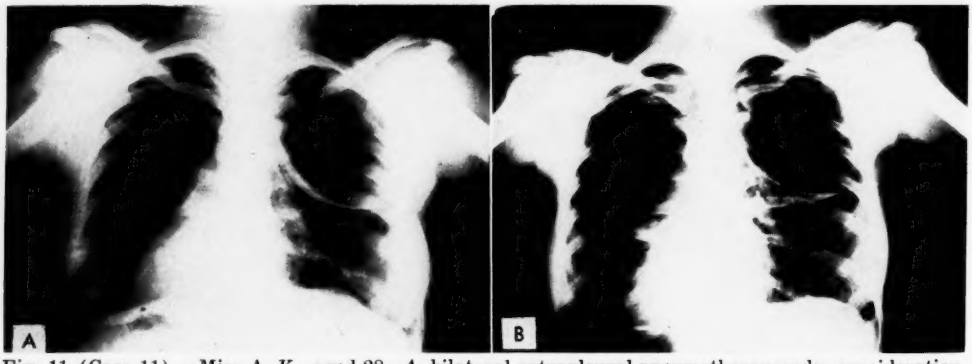

Fig. 11 (Case 11).—Miss A. K., aged 28. *A*, bilateral extrapleural pneumothorax under consideration. *B*, good double collapse obtained after bilateral extrapleural apicolysis and pneumothorax. Patient is considered cured. (Roentgenograms reversed; read left for right and vice versa.)

must be regarded as clinically cured and 10 per cent only improved.

The second group was composed of patients who were at first not considered suitable for this procedure but on whom, after the range of indications had been widened, the operation was nevertheless performed. These patients had large fibrotic cavities; in some of them the cavities were nearly peripheral. Even with 50 patients cured (71.5 per cent), the results were not sufficiently encouraging. Yet they were certainly not bad, because the cured patients maintained their good condition; in subsequent checkups I found them free from complications. It is surely justifiable, therefore, to conclude that the method offers promise for the future.

The patients are treated by inflation at different sanatoriums. I check up regularly and have noted that the amount of air given varies between 100 and 200 cc., according to the condition of the spaces, and the intervals between inflations do not exceed one month. From time to time serofibrinous liquid has accumulated, but this has vanished quickly. In 2 patients it has persisted for a year and a half but, to my surprise, has remained sterile. Three patients died within a short time after the operation (4.3 per cent). The first had a fatal hemorrhage. At necropsy, although the vessels in the neighborhood were observed to be intact, the extrapleural space was full of coagulated blood. The second died in a fortnight from secondary infection. The third went into surgical shock and died on the second

Fig. 12 (Case 12).—Mr. A. O., aged 28. *A*, bilateral fibrocaseose lesion; larger on right than on left. *B*, extrapleural pneumothorax on right side leaves sputum still productive. *C*, extrapleural pneumothorax performed on left side; sputum became sterile. (Roentgenograms reversed; read left for right and vice versa.)

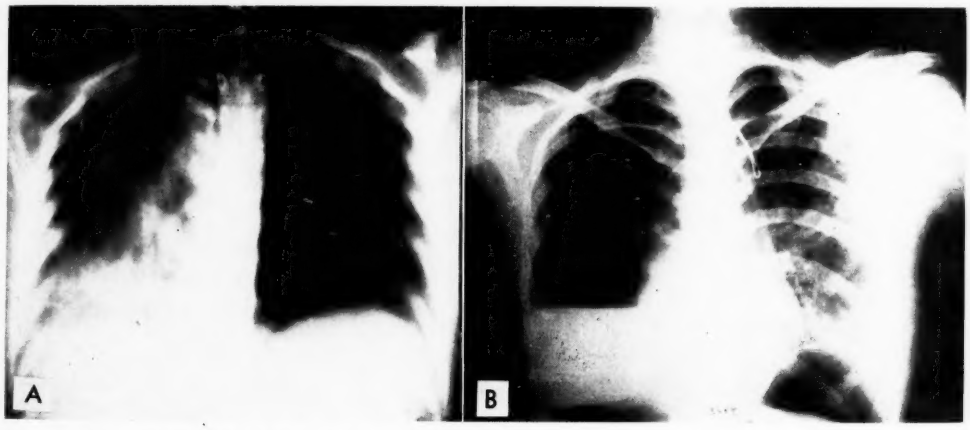

Fig. 13 (Case 13).—Miss M. S., aged 21. *A*, tomogram showing large cavity in left upper lobe. *B*, good collapse obtained by large postoperative separation. (Roentgenograms reversed; read left for right and vice versa.)

postoperative day. In 4 (5.7 per cent) of the surviving patients pleuropulmonary fistulas were encountered. They had had large peripheral cavities with fibrotic walls and adherent lung tissue. Separation of the parietal pleura was achieved poorly, and a considerable amount of fluid accumulated in the space. In 3 patients (4.2 per cent) extrapleural empyema developed. These are still under treatment, and, despite this serious complication, their general condition is improved. Later control studies have revealed the lesions unchanged in 7 cases, and I have been obliged to perform plastic operations (10 per cent). Three patients (4.2 per cent) have died lately from reactivation of the formerly arrested lesion in the opposite lung.

The results in the second group, therefore, may be summarized as follows:

Cure	Death	Perforation	Empyema	Plastic Operation Required
58	3	4	3	7

It is obvious from all this that even in such inconvenient and unsuitable circumstances, with the patient's condition otherwise nearly hopeless, a great many of the lesions were arrested and even improved.

In general, the end results for the two groups may be classified as follows:

Cure	Complications	Death
129	18	3

With regard to the results of the 150 operations performed by myself during the past two and one-half years the following conclusions have been reached:

1. Pneumothorax, which for a time was more or less out of favor, is now carried out so much more successfully that it can replace thoracoplasty in more cases than was formerly thought possible.

2. The treatment requires good technic as well as continuous and skillful medical supervision.

3. Well-planned medicosurgical cooperation is necessary in selecting the cases and also in treating any complications that may arise in the second stage.

RÉSUMÉ

Voici les conclusions de l'auteur basées sur 150 opérés durant une période 2½ ans.

1. Le pneumothorax, qui a connu une vogue plus ou moins marquée, revient maintenant de plus en plus et remplace la thorocoplastie de façon avantageuse là où autrefois, on n'onsait pas l'utiliser.

2. Le traitement demande une bonne technique et une surveillance médicale attentive.

3. Il faut nécessairement une collaboration médico-chirurgicale pour le choix des cas et l'application du traitement afin de mieux traiter les complications du deuxième stage.

SCHLUSSFOLGERUNGEN

Der Verfasser gelangt auf Grund der Ergebnisse von 150 von ihm während der letzten zweieinhalb Jahre ausgeführten Operationen zu den folgenden Schlussfolgerungen:

1. Der Pneumothorax, der zeitweilig mehr oder weniger in Ungnade gefallen war, kann heutzutage mit so viel grösserem Erfolg als früher ausgeführt werden, dass er die Thorakoplastik häufiger ersetzen kann, als man für möglich gehalten hatte.

2. Die Behandlung erfordert sowohl gute Technik als auch ständige und fachkundige medizinische Uberwachung.

3. Zur Auswahl der Fälle und zur Behandlung von Komplikationen, die im zweiten Stadium auftreten können, ist eine gut geplante medizinisch-chirurgische Zusammenarbeit erforderlich.

CONCLUSIONI

Sulla base di 150 interventi eseguiti in 2 anni e mezzo, l'autore conclude che:

1. Il pneumotorace, che per qualche tempo era stato messo in disparte, viene ora eseguito di nuovo con successi sempre maggiori così da poter sostituire la toracoplastica in un numero di casi maggiore di quanto non si credesse in seguito.

2. La cura richiede una tecnica accurata e un controllo continuo e attento.

3. E' necessario un accordo medico-chirurgico per scegliere i casi e per trattare le complicazioni che possono sopravvenire.

CONCLUSIONES

Se llega a las siguientes conclusiones, en relación con los resultados de 150 operaciones practicadas por el autor durante el año y medio préximo pasado:

1. El neumotórax que por algun tiempo fué más ó menos favorecido se lleva a cabo actualmente con mayor éxito pudiendo substituir a la toracoplastía en mayor número de casos de losque se pensaron anteriormente posibles.

2. El tratamiento requiere una buena técnica, así como una experta y continua supervisión médica.

3. Un cooperación médico - quirúrgica bien planeada es necesaria en la selección de casos, así como en el tratamiento de cualquier complicación que pueda surgir en el segundo período.

REFERENCES

Brunner: Extrapleurale pneumolyse, Helvetica chir. acta October 1946.

Tompson, B. C.: Decollation of Intrapleural Adhesion by Open Extrapleural Pneumolysis, J. Thoracic Surg. No. 4 1949.

Berg, S.: Combined Intra and Extrapleural Pneumothorax mixte, Acta Med. Scand. 1946.

Despierrs, G.: Le pneumothorax Extrapleurale chirugicale: ses possibilites et ses resultas, J. de Med. Lyon, 1946.

Donato, A.; Surgical extrapleural pneumothorax. Mexico 1948.

Le foyer, and Delbecq, E.: Le traite du pneumothorax extrapleural, Paris 1950.

Heaf, F., and Rusby, L.: Recent Advances in Respiratory Tuberculosis, London 1948.

Trent, J. C., and Moody, J.: An Evaluation of Extrapleural Pneumolysis, J. Thoracic Surg. April 1949 No. 2.

Iselin, M.: Apicolyse endofascial, Traite de tech. chir. 3:1944.

Murstad, E.: Extrapleural Pneumothorax, Nord. Med. January 1947.

Nissen, R.: Cerrahi Endikasyonlar, Istanbul 1938.

Mully, K.: Extrapleural Pneumothorax: Indications, Complications och results, Nord. Med. 1947.

Reid, H.: Extrapleural Pneumothorax in the Treatment of Pulmonary Tuberculosis, Thorax 19:347-373, 1948.

Sauerbruch, F.: Chirurgie der brustorgane. Berlin, 1925.

Schmidt, M.: Le pneumothorax extrapleural, Rev. de la tuberculose 3:1122-1136, 1937.

O'Neill, T. J.: Experimental and Clinical Study of Collapse Therapy, J. Thoracic Surg. 1949.

Tezelli, S.: Akciger tuberkulozunun tedavisinde ekstraplöral pnömotorakstan aldigimiz neticeler, XI inci Milli Türk Tip kongresi, Ankana.

Veli Behcet Kurdoglu: Ekstraplöral pnömotoraks hakkinda Hastane. Istanbul: Ocak, 1950.

It is more easy to get a favor from fortune than to keep it.
—Publilius Syrus

Fortune dreads the brave, and is only terrible to the coward.
—Seneca

Fortune brings in some boats that are not steer'd.
—Shakespeare

Fortune does not change men; it unmasks them.
—Mme. Necker

Fortune is like glass—the brighter the glitter, the more easily broken.
—Publilius Syrus

Reflect upon your present blessings of which every man has many; not on your past misfortunes, of which all men have some.
—Dickens

Rehabilitation of Patients with Spastic Paralysis

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IT is the purpose of this presentation to offer certain intrinsic neuromuscular responses for the consideration of the orthopedic specialist who is interested in corrective therapy and rehabilitation.

The discussion will be limited to the spastic types of paralysis of infancy, childhood and the adult years of life. Types of rigidity and dystonia will be mentioned only to exclude them by the differential means of diagnosis now at hand. The treatment of these three conditions is quite different, and they should, therefore, not be mistaken or confused if satisfactory levels of rehabilitation are to be obtained.

In the last analysis, the problem of spastic paralysis, with its *contraction* and *contracture* deformities, is primarily neurologic, and it is high time that the neurologist gave some aid to the orthopedist, who has carried the burden of these chronic states for so many years.

After a prolonged and careful study of the origin of human movement, it is now possible to obtain certain advantages from retained *normal* and *pathologic reflexes* that have not heretofore been called upon to do their share in the therapy of rehabilitation. These are the well-known reflexes of spastic forms of paralysis which are intrinsic to the cord and obtained through superficial and deep peripheral stimuli.

In other words, instead of the therapist's expending effort on passive or routine exercise of the muscles of the trunk and extremities, this exercise can be obtained by making various selected reflex arcs do the active work in their own way (which proves to be superior) and with it gain not only the activity phase of muscle contraction but the beneficial coincident effects of vasomotor response and the intrinsic values of muscle volume and strength. It has become a simple form of therapy and has led to the integration of certain of these simple reflex responses into a spreading and coordinate type of movement which, with other reflex augmentation, produces a typical amphibian pattern of progression, an extremity response that underlies all of the human walking components.

It is clear, from the "tonic neck reflex" to the mass reaction of defense or the postural reflex (Marie-Foix), that spastic man is but a reflex robot, with loss of voluntary control; nevertheless, he can put on a powerful act at the amphibian level if properly timed and sequenced in serialized patterns of progression (belly down) without a cortical motor area. With a properly devised motor end point stimulator, rigged like an automobile commutator, sequence may be made to simulate the walking gait. This proved to be valuable with several paraplegic patients.

This all adds up to the fact that crude walking, feeding and self-care patterns of movement remain in the human being to be exploited after loss of the higher voluntary levels, and these can be trained for the purpose of released spasticity, coordinate movement and useful purposes if one reenacts the type of movement for which they were designed four hundred million years ago.

One must not forget that the amphibian-reptile vertebrates walked with their type of extremities long before the pallial hemispheric masses developed in the mammal and in man. This great higher brain mass (which we have so long worshiped) serves its purpose in the form of motor *skills* that arose with fingers, stereoscopic vision and the two-footed upright posture with arms and hands free to act.

Some of the values of the normal and

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pathologic reflex response in training and the "unlooking" reflexes which are reciprocal modifiers for the spastic tone that has so often led to contraction deformity, if this is prevented in its early stages by proper postural and pattern activity utilizing the lower level controls of the nervous system, it may do much to aid the orthopedic specialist in the correctional measures to be eventually employed.

"Unlocking reflexes" refer to positions and movements of the neck or extremities which cause automatic release or relaxation of hypertonic (spastic) muscles or muscle groups.

The sensory component of the "unlocking reflex" apparently chiefly concerns posture and joint position, as well as muscle stretch augmented by peripheral resistence against the parts involved.

My studies on the origin of human movement indicate this phenomenon is not a simple single muscle response but concerns the automatic release of groups of muscle conceived with a primitive "pattern of movement," originally with the purpose of projecting the trunk forward as an act of progression.

Familiar simple tendon and superficial "reflex" response play a subordinate role to the higher integration of "mass reaction" activity, which in time sequence just precedes a purposeful act.

To obtain and apply these "unlocking" responses to the spastic types of paralysis, the following concept must be carefully simulated and effected:

The patient must be placed in the prone position with chin (mouth) in the midline. This establishes the postural-vestibular values of the early vertebrate types (fish-amphibian) upon which all so-called reflex mechanisms "normal" or "pathological" have been established.

The rotation and slight lateral flexion of the head from side to side in a ventral arc (tonic neck reflex) initiates homolateral forward movement of the extremities on the side toward which the oral structure is turned, and at the same time "unlocks" or reciprocally relaxes the contralateral components.

This original eye-head-neck component "sequentially conditions" the *power flow* to follow in the presenting parts, initiating ventral projection forward of the body mass as well as "unlocking" preparations for the next phase of the progression cycle.

In the evolutionary time scale this represents 450,000,000 years of neuromuscular response (fish) arising from the reticular mass at the level of the aqueduct of Sylvius.

Patterns of movement that followed this initial integration with evolution of the extremity structures established the homolateral sequence of patterns emerging throughout the era of amphibian life.

The "unlocking" postural movement sequence follows in shoulder-arm-forearm-hand and fingers sequence as the part is swept in a two-dimensional downward and backward thrust against peripheral resistance (water-mud-earth). This was originally designed to accomplish projection, as the head turned toward the contralateral advancing side.

The next level of evolutionary advancement (reptile-turtle), brought three-dimensional antigravity postural mechanisms into "off the ground" integration of movement. Joint and antigravity postural mechanisms became involved.

For instance, to "unlock" a spastic arm and forearm, the patient is placed in the prone position, head-neck turned *away* from the part, elbow elevated to the shoulder level and flexed 90 degrees. The hand and wrist are drawn *down, under* and slightly outward from the elevated arm position, the humerus being rotated 30 degrees (turtle type). The spastic biceps automatically relaxes ("unlocks") when the extremity has accomplished approximately 130 degrees of lateral arc.

The "unlocking reflex" of the wrist and hand occurs as the part (palm up) completes the 180 degree thrust to a position almost above the buttocks.

The "unlocking reflex" of the spastic fingers is accomplished in this position by adducting the thumb to an opposable position.

Voluntary movements of spastic fingers

may now appear in this relaxed position if proper efforts are made by the patient (*provided* the thumb is brought into an apposable position to the middle finger by use of the phalangeal-metacarpal joint ("unlocking reflex of fingers with extension").

The proper appositional position of the thumb is required before a "purposeful" prehensile act can be initiated.

Higher levels apparently do not offer functional response until posture is correct for *purpose* (picking up or holding an object in the fingers).

Because the head and eyes are turned away from the hand (in the palm-up over the buttocks position of relaxation), two mirrors are required to train the patient in visual reinforcement of attempts to "capture," correlate and use whatever finger movements remain and are obtainable. These efforts have made possible self-feeding and other crude skills in the majority of subacute or chronic types of spastic patients.

It is obvious that, as these movements arise at primitive levels at or below the reticular pons, pathologic change involving higher levels and the cortex (common stroke) do not affect them except as to voluntary higher mammal-man types of skills and coordination.

Reflex and "unlocking reflex" activity can then be "conditioned" and established in useful forms of integration at the crude primitive levels of motor expression. Skillful use of the fingers and hand (cortical) cannot be reestablished unless the higher levels are intact. Prehensile grasp and feeding movement, however, can be accomplished with proper training if lower primitive levels are functioning. A valuable aid to rehabilitation is, therefore, available.

This brief account will indicate the usefulness of common reflexes for initiating primitive patterns of movement and reciprocal "unlocking" responses that occur coincidentally. Both factors are of great value in programs of physical therapy and rehabilitation.

The same factors are present in the lower extremities, although the sacral bulb is apparently a more self-organized unit under associated control and coordination.

The "unlocking" sequence of the trunk and lower extremities follows those of the upper a fraction of a second later. The same trunk projection purpose is involved.

Flexion of the toes at the phalangeal metatarsal joint produces a "withdrawal," "mass reaction" or "supporting reflex" with flexion and abduction ("unlocks" the extensors and adductors), Babinski, Chadduck reflex unlocks, fanning and extension of toes and flexion of the ankle; prolonged ankle clonus gives intrinsic exercise to the calf muscles, etc.

Properly timed, coordinated and conditioned use of these "reflexes" in conjunction with the tonic neck reflex sequence makes semiautomatic crawling and later walking possible. Relaxation of spastic tone ensues for the benefit of the therapist and patient.

Utilization of "normal" and "pathologic" reflexes (inherited from evolutionary patterns of movement) with their "unlocking" reciprocal components under proper posture and sequence have been of great therapeutic and rehabilitation value in spastic types of paralysis observed in man.

SUMMARY

The author describes certain intrinsic neuromuscular responses that can be used to advantage in the rehabilitation of patients with spastic paralysis. It is pointed out that the problem of spastic paralysis is primarily neurologic and that the orthopedist is in need of the neurologist's cooperation.

The responses concerned are well-known reflexes associated with spastic paralysis, intrinsic to the cord and obtained by means of superficial and deep peripheral stimuli. In the author's opinion, employment of these reflexes will produce better results than those observed after treatment by passive exercise. Even after loss of the higher voluntary levels, crude patterns of movement remain in the hu-

man being, and these can be trained to obtain released spasticity, coordinate movement and useful activity.

RÉSUMÉ

L'auteur décrit certaines réactions neuro-musculaires intrinsèques qui peuvent être utilisées pour le traitement des patients atteints de paraplégie spastique. Il est souligné que la thérapeutique de la paralysie spastique est avant tout neurologique et que l'orthopédiste a besoin de coopérer avec le neurologue.

Les réflexes de la paralysie spastique sont bien connus et sont obtenus, en passant par la moelle, au moyen d'excitations superficielles ou profondes. D'après l'auteur, l'utilisation de ces réflexes procurent des résultats meilleurs que ceux observés après traitement par exercice passif. Même après la perte des centres les plus élevés, des ébauches de mouvements restent dans l'organisme; ils provoquent, par l'entraînement, une spasticité modérée, des mouvements coordonnés et une utile activité.

ZUSAMMENFASSUNG

Der Verfasser beschreibt gewisse neuromuskuläre Reaktionen, die man vorteilhaft zur Wiederherstellung von Kranken mit spastischen Lähmungen ausnützen kann. Er betont, dass die spastische Lähmung in erster Linie ein neurologisches Problem darstellt, und dass der Orthopäde auf die Unterstützung des Neurologen nicht verzichten kann.

Bei den erörterten neuromuskulären Reaktionen handelt es sich um wohlbekannte bei der spastischen Lähmung vorkommende Reflexe, die dem Rückenmark angehören und mittels oberflächlicher und tiefer peripherer Reize ausgelöst werden. Die Heranziehung dieser Reflexe ergibt nach Ansicht des Verfassers bessere Ergebnisse, als nach Behandlung mit passiven Übungen beobachtet werden. Gewisse grobe Bewegungsmechanismen bleiben beim Menschen selbst nach Verlust höher gelegener willkürlicher Zentren erhalten, und wenn diese trainiert werden, lässt sich eine Erschlaffung der Spastizität, Koordination der Bewegung und nützliche Aktivität erreichen.

RIASSUNTO

L'autore descrive alcuni riflessi neuromuscolari di natura intrinseca, utili ai fini della riabilitazione di pazienti affetti da paralisi spastiche. Si sottolinea il fatto che il problema della paralisi è sopratutto d'ordine neurologico, cosicchè all'ortopedico è indispensabile la collaborazione del neurologo. I riflessi in questione sono notoriamente associati con la paralisi spastica, e si possono ottenere a mezzo di stimoli periferici superficiali e profondi. L'autore pensa che la provocazione di tali riflessi possa dare risultati migliori di quanto solitamente si ottiene con la chinesiterapia. Anche dopo la perdita della possibilità di movimento attivo, nel corpo umano restano le vie di trasmissione e queste possono essere utilizzate allo scopo di ottenere la remissione della paralisi spastica, movimenti coordinati ed una utile attività.

RESUMEN

El autor describe ciertas respuestas neuromusculares intrínsecas que pueden usarse con ciertas ventajas en la rehabilitación de pacientes con parálisis espástica. Se señala que el problema de la parálisis espástica es primordialmente neurológico y que el otropedista requiere la cooperación del neurólogo.

Las respuestas concernientes son refelejos bien conocidos que se presentan con la parálsisiespástica, medulares intrínsecos y obtenibles por estímulos periféricos superficiales y profundos. En la opinión del autor el uso de estos reflejos producirá mejores resultados que los que se obtienen por los tratamientos de ejercicios pasivos. Aun después de la pérdida voluntaria de los níveles superiores permanecen ciertos movimientos que ejercitándose pueden mejorar la espasticidad, coordinar el movimiento y redundar en actividad útil.

Subacute Disseminated Lupus Erythematosus and Uneventful Pregnancy

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THE current major publications dealing with obstetrics make little or no reference to the effect of pregnancy on lupus erythematosus. The few cases reported present conflicting results.

Crawford and Leeper[1] reported 3 pregnancies associated with local discoid lupus erythematosus. One patient became worse during pregnancy and improved greatly one month post partum; in another the disease became systemic and she died one day post partum, though the infant survived; the third was delivered of a stillborn fetus during the eighth month of gestation and remained alive for five years, after which time she succumbed to an acute exacerbation of disseminated lupus erythematosus.

Ellis and Bereston[2] treated 3 patients with acute disseminated lupus erythematosus complicated by pregnancy. None of these women and none of their infants survived. These authors reviewed the literature up to 1952 and also summarized the reports they obtained by questionnaire from 280 dermatologists. Of 56 patients with acute lupus erythematosus, 14 died and 11 became worse during pregnancy. Of the 13 patients with subacute lupus, 6 had spontaneous abortions, 3 became worse and 7 improved during pregnancy. Thirty-one patients with chronic discoid lupus were not affected by pregnancy.

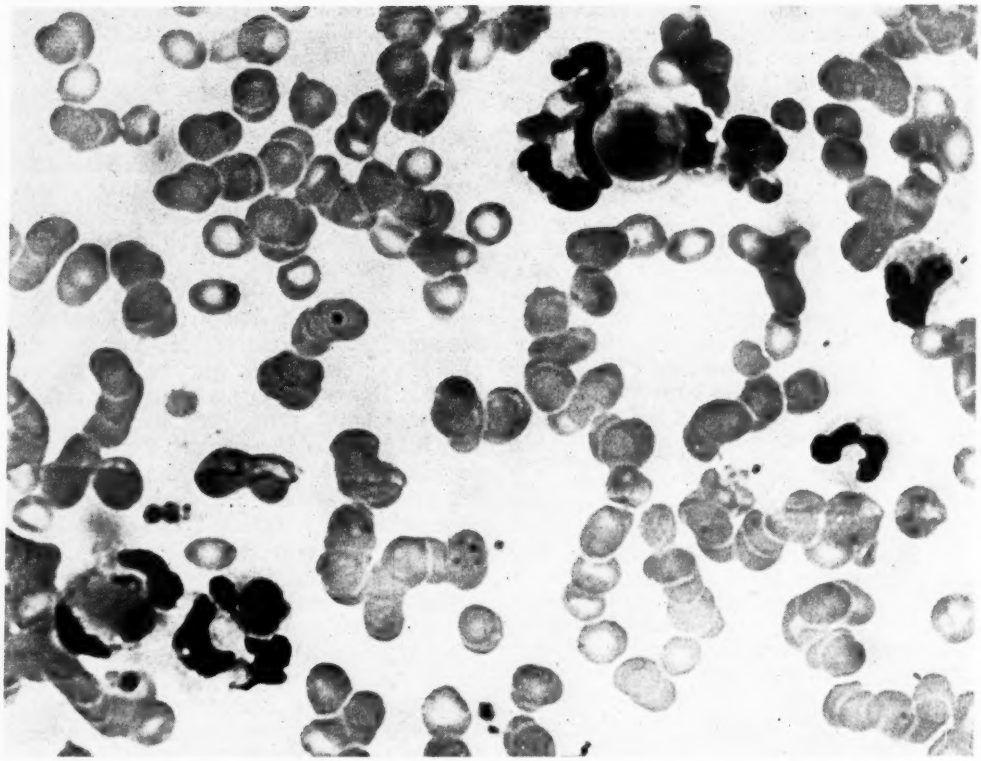
Recently we had the opportunity to observe an uneventful pregnancy in a patient with subacute disseminated lupus erythematosus who had two severe acute exacerbations of the systemic disease within six months before the onset of gestation.

Submitted for publication April 10, 1954.

REPORT OF CASE

Mrs. G. B., a white roentgen laboratory technician 21 years old, presented herself to one of us (E. K.) on April 7, 1951, with complaints of pain and swelling of the ankles and knee joints, generalized pain and swelling of the hands, fever and general body ache of three years' duration. The symptoms were intermittent and became worse during the summer. Pain in the left calf had begun about one year earlier and had become worse during the past three weeks, during which time a classic butterfly rash had appeared. Previous medical care had been directed toward treatment of arthritis, rheumatism, virus disease and infection of the kidneys. Otherwise the history was essentially normal.

She was admitted to Mount Sinai Hospital the next day. The blood pressure, pulse rate and respiratory rate were normal; the oral temperature was 99.6 F. The face presented symmetric, sharply defined scaly patches, varying in configuration, over the malar prominences and the eyelids. The heart had a soft blowing systolic murmur limited to the apex. The lungs and abdomen were normal. Tenderness was elicited over the muscles of the left calf, and tenderness and swelling over the left metacarpal-phalangeal joints. A few small, discrete lymph glands were observed in the right axilla and the submandibular region. Laboratory studies disclosed an erythrocyte count of 3,290,000 per cubic millimeter of blood, with 10.1 Gm. of hemoglobin, and a leukocyte count of 8,000 per cubic millimeter. The differential count was as follows: stab cells, 16 per cent; segmental cells, 54 per cent; lymphocytes, 28 per cent, and monocytes, 2 per cent. Kahn and Kline tests gave negative results. The sedimentation rate was 43 mm. per



Peripheral blood smear illustrating cell characteristic of systemic lupus erythematosus.

hour. The blood chemical values, which included those for sugar, urea nitrogen, sodium, potassium, chlorides and carbon dioxide combining power, were within normal limits. The value for total proteins was 7.8 Gm., that for albumin 4.3 Gm. and that for globulin 3.5 Gm. per hundred cubic centimeters. A twenty-four hour urinalysis revealed a trace of albumin. The specific gravity of the urine was 1.012. Preparations of peripheral blood and bone marrow gave strongly positive reactions for lupus erythematosus. A thoracic roentgenogram and an electrocardiogram revealed no abnormality.

On completion of the aforementioned studies the patient was given 40 mg. of ACTH every six hours, 1 Gm. of potassium chloride three times a day, 2 pabalate tablets four times a day, a low sodium diet and supplemental vitamins. Whole blood (250 cc.) was administered twice. Within a few days the cutaneous eruption, the pain and swelling of the joints and the slight elevation of temperature subsided gradually and finally disappeared. The CBC also improved to normal range. ACTH was diminished to 25 mg. four times a day, and a change was finally made to cortisone in the same dosage. A flare-up of symptoms recurred and was controlled with an increase of cortisone to 30 mg. every six hours. The patient was released from the hospital with this dosage on April 29, 1951, twenty-two days after admission.

During the next fifteen months she was under constant observation, taking cortisone in amounts varying from 45 to 125 mg. daily; pabalate tablets, 4 daily, and potassium chloride, 15 gr. daily. The blood electrolytes were checked every month. Forty units of ACTH twice a week was added to provide for adrenal stimulation.

The patient was rehospitalized in July and September 1952 for recurrence of symptoms comparable to those present on her first hos-

pitalization, except that they were much more severe. In each instance she responded to large doses of cortisone, at times as high as 240 mg. daily. The dose of cortisone was gradually decreased to 50 mg. daily.

The first antepartum examination was done on March 14, 1953. The expected date of confinement was September 11. No significant facts were elicited from the family or past history other than those already mentioned. The menses began at the age of 14 and occurred at intervals of four and five weeks, with a moderate flow and no associated symptoms.

Examination revealed that the blood pressure in millimeters of mercury was 138 systolic and 80 diastolic, the pulse rate 82, and the weight 137½ pounds (62.4 Kg.). The eyes, ears, nose and throat were normal, as were the heart, lungs and breasts. There was a palpable abdominal mass 8 cm. above the symphysis pubis. Pelvic examination revealed a normal nulliparous introitus; the cervix was soft and slightly eroded; the corpus uteri was soft, anteflexed, freely mobile and enlarged to approximately the size of three months' gestation. The adnexae were normal. The pelvic measurements were within normal limits for a normal medium-sized gynecoid pelvis.

At this time patient was taking 50 mg. of cortisone, 15 gr. of potassium chloride and 250 mg. of ascorbic acid daily. A multiple vitamin compound was added to her diet, which was salt-free. She remained under the same management throughout her pregnancy. Her total weight gain was 2 pounds (0.9 Kg.). The B.P. never rose above 140 systolic and 90 diastolic, and the urine, blood picture and electrolytes remained normal at all times. The membranes ruptured spontaneously on September 2, 9 days before the due date, and the patient was admitted to the hospital. Labor began at 1:20 a.m. the next day, and at 4:15 a.m. a living female infant weighing 6 pounds and 7 ounces (3,919 Gm.) was delivered with the aid of a midline episiotomy and outlet forceps application. The third stage of labor and the postpartum course were uneventful. A repetition of the blood count and of the tests for blood chemical values and electrolytes gave normal results. Cell tests for lupus erythematosus gave weakly positive reactions. The patient was discharged from the hospital five days postpartum. When last seen, early in December 1953, both she and the baby were clinically well. The mother still has a rare lupus erythematosus cell in the peripheral blood. A preparation of the baby's peripheral blood gave negative results for this disease.

COMMENT

Disseminated lupus erythematosus is invariably a fatal disease. With the introduction of ACTH and cortisone as therapeutic agents the disease may frequently be controlled. Crawford and Leeper[1] stated that pregnancy is not well tolerated by women with extensive lupus erythematosus. Ellis and Bereston[2] concluded that pregnancy does not affect the course of lupus erythematosus and that at no time should pregnancy be interrupted. Haserick[3] recommended that pregnancy be permitted if the patient enters a good steroid remission for one year prior to the onset of gestation.

Because of religious considerations our patient became pregnant two months after an acute exacerbation. Despite the short interval she had an uneventful course on a constant dosage of 50 mg. of cortisone daily. From the results in our case, it seems that, with the aid of cortisone and/or ACTH, patients with systemic subacute lupus erythematosus may go through pregnancy uneventfully.

SUMMARY

1. A case of subacute disseminated lupus erythematosus complicated by pregnancy is presented.

2. Conception occurred approximately three months after an acute exacerbation of disseminated lupus erythematosus while the patient was being given a maintenance dose of 50 mg. of cortisone daily.

3. Gestation, labor and puerperium were uneventful.

4. The infant was not affected by the mother's disease, and at the time of writing the mother is still receiving 50 mg. of cortisone daily and is clinically well.

RÉSUMÉ

1. L'auteur présente un cas de lupus érythémateux subaigu et disseminé, com-

pliqué par la grossesse.

2. La conception eut lieu approximativement trois mois après une crise aiguë de lupus érythémateux disséiné, alors que la malade recevait une dose continue de 50 mg. de cortisone par jour.

3. La grossesse, l'accouchement et les suites de l'accouchement ne présentèrent pas de complication.

4. L'enfant n'a pas été affecté par la maladie de sa mère, et au moment où l'auteur écrit cet article, la malade reçoit encore 50 mg. de cortisone par jour; son état est cliniquement satisfaisant.

ZUSAMMENFASSUNG

1. Es wird über einen Fall von durch Schwangerschaft kompliziertem subakutem disseminiertem Lupus erythematosus berichtet.

2. Die Konzeption erfolgte etwa drei Monate nach akutem Aufflackern eines disseminierten Lupus erythematosus, während die Kranke sich auf einer kontinuierlichen Behandlungsdosis von 50 mg Cortison pro Tag befand.

3. Schwangerschaft, Entbindung und Wochenbett verliefen ohne Zwischenfälle.

4. Das Kind war von der mütterlichen Erkrankung nicht befallen, und die Mutter befand sich zur Zeit der Niederschrift dieser Arbeit in gutem klinischen Zustand unter kontinuierlicher Fortführung der Cortisonverabreichung von 50 mg pro Tag.

RESUMEN

1. Se comunica un caso de lupus eritematoso diseminado subagudo complicado por embarazo.

2. La concepción ocurrió tres meses después de una exacerbación de lupus eritematoso diseminado, cuando el paciente estaba recibiendo una dosis de sostén de 50 mg. de cortisona diarios.

3. La gestación, el parto y el puerperio fueron normales.

4. El niño no fué afectado por la enfermedad materna y en el momento de escribir este artículo la madre estaba recibiendo sus 50 mg. de cortisona diarios y se encontraba bien clínicamente.

RIASSUNTO

1. Viene presentatoun caso di lupus disseminato eritematoso complicato da gravidanza.

2. La fecondazione avvenne circa 3 mesi dopo una riacutizzazione del lupus, mentre la paziente era in cura cortisonica (50 mg. di cortisone al giorno).

3. Gravidanza, parto e puerperio furono normali.

4. Il neonato non presentava alcuna malattia e, fino alla pubblicazione del lavoro, la madre stava bene e continuava la cura con il cortisone.

REFERENCES

1. Crawford, G. M., and Leeper, R. W.: Diseases of the Skin in Pregnancy, Arch. of Derm. & Syph. 61:753-771, 1950.

2. Ellis, F. A., and Bereston, E. S.: Lupus Erythematous Associated with Pregnancy and Menopause, Arch. Derm. & Syph. 65:170-176, 1952.

3. Haserick, J. R.: Personal communication.

I have lost everything, and I am so poor now that I really cannot afford to let anything worry me. —*Joseph Jefferson*

Worry, the interest paid by those who borrow trouble. —*George W. Lyon*

The Importance of Cervical Lacerations in the Management of Habitual Abortions

Report of a Case

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ONE is sometimes faced with the problem of women who have had a baby many years ago and who, in subsequent pregnancies, have failed to carry the conceptus to term, aborting at various stages of gestation. It is imperative to put these women through a complete sterility study, including a basal metabolism test, hystersalpingographic studies, endometrial biopsy and the Huhner test, to exclude all other factors that may have caused the repeated abortions. Occasionally one elicits the history of a previous difficult instrument delivery that resulted in deep unilateral or bilateral lacerations of the cervix. It is such cases that this paper is dealing with.

In checking the standard textbooks on gynecology and sterility, one searches in vain for the statement that lacerations of this type may be responsible for repeated spontaneous abortions. Yet, in foreign textbooks, references can be found to that effect. Halban[1] stated: "Of great importance are cervical lacerations, because the cervical canal gets excessively patent as pregnancy progresses and the lower pole of the ovum loses its necessary support. Those lacerations which extend by taut scars into the parametrium and the vagina are particularly troublesome, since the scars will exert a traction and thus irritation upon the uterus, which will result in contractions. Such lacerations are to be closed by the Emmet's operation." The same opinion was expressed by Martius.[2] It is interesting to note that Emmet's trachelorrhaphy has become obsolete in the United States during the past two decades, and has mostly been replaced by electrocauterization or conization of the cervix. Te Linde[3] stated, "In the past 10 years the author has performed a single trachelorrhaphy. The indication was a very deep cervical tear in a woman who had had several premature labors at about seven months. The deep laceration of the circular cervical musculature was thought to be a possible cause of the patient's inability to carry the child to term. Following the repair, the patient went to term with the next pregnancy." With these quotations in mind, the following case, in which the condition was similarly treated, is reported.

From the Department of Obstetrics, Elizabeth General Hospital, Elizabeth, N. J.

REPORT OF CASE

Mrs. T. S., 28 years old, was first seen on Jan. 5, 1952, after having been referred by another physician because of habitual abortions. She stated that she had had a very difficult forceps delivery in 1941, after forty-eight hours of labor. It ended in the birth of a boy weighing 8 pounds and 3½ ounces (3,728 Gm.). This confinement resulted in a deep bilateral cervical laceration which caused low backache and vaginal discharge. Therefore in January 1945, the patient was operated on at the Nix Memorial Hospital in San Antonio, Texas, at which time a repair of the cervix (modified Sturmdorf), a suspension and an appendectomy were done. The operative report reads as follows:

"Patient was prepared in the usual manner, cervix found to have a long anterior and posterior lip, because of the bilateral laceration, with marked inflammatory changes of both lips. A modified Sturmdorf was done. Hemostasis was secured. All raw areas covered with

normal mucous membrane tissue. Pack inserted for hemostasis.

"Patient's abdomen was then prepared in usual manner, peritoneal cavity entered, retrodisplaced uterus found. Uterosacral ligaments were shortened, cul-de-sac was closed, round ligaments on both sides brought to the anterior surface of the uterus by the Coffee method. Rest of the tissue was normal. Appendix was then removed and found to be chronically inflamed. Appendix was removed in the usual manner using no purse-string, phenol and alcohol to base. Abdomen closed in usual manner, continuous plain to peritoneum, continuous chromic to fascia, interrupted wire to fascia and skin clips."

She then had a five-month spontaneous abortion in October 1945, a six-week spontaneous abortion in July 1946, a six-week spontaneous abortion in June 1948 and another in December 1951 which also was at about six weeks. None of these abortions required dilation and curettage.

When first seen, the outlet had good support. There was a moderate vaginal discharge. The vaginal mucosa was normal except for several inclusion cysts in the anterior vaginal wall. The cervix showed bilateral deep lacerations, with eversion of both anterior and posterior lips, which appeared firm and stubby. Inspection of the cervix did not substantiate the report that any amputation (modified Sturmdorf?) had been performed. The uterus was anteflexed and of normal size and shape. Both adnexae were normal. Tests for basal metabolism, hysterosalpingographic study, an endometrial biopsy and a Huhner test all gave perfectly normal results. In the final report the patient was told that no explanations for her four previous miscarriages could be found except the bilateral laceration of the cervix, and it was suggested that she be admitted to this hospital for plastic repair of the cervical canal. On June 28, 1952, a dilation and curettage, followed by a trachelorrhaphy (Emmet's operation) was performed. The operative observations were as follows: "Moderate relaxation of the outlet is noted. There is a deep laceration on both sides of the cervix, reaching into the vaginal vault, with marked eversion of both lips. Many Nabothian cysts, as well as chronic endocervicitis, were noted. The uterus is of normal size and freely movable. The adnexae are not enlarged. Dilatation and curettage were performed and a large amount of velvety endometrium removed. A triangular piece of cervical mucous membrane was excised from the anterior and posterior lips on the right side, and the two raw surfaces were brought together with interrupted sutures of No. 1 chromic catgut. The sutures were left untied. The same procedure was repeated on the left side, after which all sutures were tied, and a new cervical canal was formed into which a 1-inch (2.3 cm.) iodoform gauze strip was inserted like a wick." The patient made an uneventful recovery and was discharged from the hospital after three days. She was seen again four weeks after the operation, and the cervix appeared well healed. She then was instructed to try to become pregnant in August 1952.

She had her last menstrual period on October 1. A Friedman test done on November 14 gave a positive result. The patient was given normal antepartum care. Her pregnancy progressed uneventfully and the membranes ruptured at 8 a.m. on July 5, 1953. She went into labor spontaneously at 2:30 p.m. on the same day. She had a short and unremarkable labor and was delivered of a normal boy weighing 7 pounds and 8 ounces (3,402 Gm.) at 8:37 p.m. After delivery the cervix was exposed and inspected, and it was observed that both suture lines on the lateral aspects of the cervix had torn open again. In addition there was a vaginal tear, so that the right labium minus was torn off from the vaginal mucous membrane. The cervical lacerations as well as the vaginal tear were repaired in the usual manner, with interrupted sutures of No. 00 chromic catgut.

This case seems to prove that a bilateral cervical laceration sustained at a previous difficult operative delivery may be a reason for future spontaneous abortions. In evaluating these cases, not enough attention is paid to the cervical factor, and in patients with habitual abortions, where no other pathologic change can be found that may be responsible for these continuous mishaps, repair of cervical lacerations by means of Emmet's trachelorrhaphy appears to be a worthwhile procedure.

SUMMARY

A case of habitual abortion due to bilateral cervical lacerations suffered at a previous operative delivery is presented. After Emmet's trachelorrhaphy had been performed, the woman became pregnant

and was spontaneously delivered of a living child.

RÉSUMÉ

L'auteur présente un cas d'accouchement qui nécessita une opération et des incisions bilatérales du col et qui fut, par la suite, la cause d'un avortement. Après avoir subi l'opération d'Emmet, la malade devint à nouveau enceinte et accoucha spontanément d'un enfant vivant.

RIASSUNTO

Viene descritto un caso di aborto abituale dovuto a lacerazioni bilaterali della cervice consecutive ad un precedente parto distocico. Dopo una trachelorrafia secondo Emmet la paziente portò a termine una gravidanza ed ebbe un parto normale.

RESUMEN

Se comunica un caso de aborto habitual debido a laceraciones bilaterales del cervix sufridas en un parto operatorio previo. Después de la traquelorrafía de Emmet la mujer se embarazó tuvo un parto espontáneo con niño vivo.

ZUSAMMENFASSUNG

Es wird ein Fall von habituellem Abort infolge von doppelseitigen Gebärmutterhalszerreissungen, die bei einer früheren operativen Entbindung entstanden waren, beschrieben. Nach Ausführung einer Emmetschen Trachelorrhaphie wurde die Frau schwanger, und es erfolgte spontane Entbindung eines lebenden Kindes.

REFERENCES

1. Halban, J.: Gynaekologische Operationslehre. Second Edition. Vienna: Urban and Schwarzenberg, 1947, p. 353.
2. Martius, H.: Die Gynakologischen Operationen. Leipzig: Georg Thieme, 1937, p. 204.
3. Te Linde, R. W.: Operative Gynecology. Philadelphia: J. B. Lippincott Company, 1946, p. 351.

Young men wish: love, money and health. One day they'll say: health, money and love.

It is strange that thought should depend on the stomach, and still that men with the best stomachs are not always the best thinkers.

Before undergoing a surgical operation arrange your temporal affairs. You may live.

Ugliness is a point of view: an ulcer is wonderful to a pathologist.

An Improvised Frame for Temporary Splinting in the Treatment of Congenital Dislocation of the Hip

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AFTER reduction of congenital dislocation of the hip, if the surgeon has elected to use plaster of paris casts in the frogleg position, several changes are necessary for reasons of hygiene and also because of the growth of the child. At times, however, when a change of cast is contemplated and one is still in the stage of treatment at which maintenance of the position of abduction and flexion of the thighs is important, one may find it impracticable to apply a new cast. The old cast is now odorous and soiled, and the skin underneath may be covered with macular and pustulous lesions; it is generally red and partly macerated from contact with the cast. The cutaneous lesions have to be treated for a number of days before a new cast can be applied, and at the same time one does not want to change the frogleg position.

In such a situation a frame that can be improvised in a few minutes has proved exceedingly useful. It could also be used when intercurrent disease makes it necessary to remove the cast, although such an occasion has not arisen in my own experience.

The frame is shaped by taking a length of Kramer wire ladder splint 17½ to 18 inches (44.3 to 45.7 cm.) long and 3½ inches (8.9 cm.) wide and bending it in such a manner that one long and the two short sides of a rectangle are formed. The long side corresponds to the distance between the right and left popliteal area with either thigh in the flexed and abducted position. The short side corresponds to the length of the posterior aspect of the right and left leg, respectively, from the popliteal fossa down to 1½ inches (3.7 cm.) above the ankle joint. The mid-

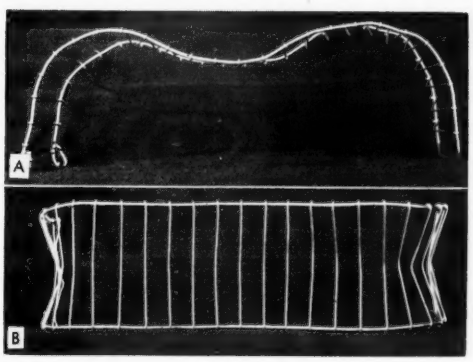

Fig. 1.—Frame shaped from Kramer wire splint.

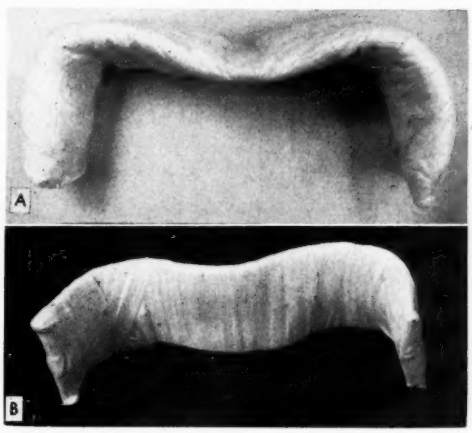

Fig. 2.—The padded frame.

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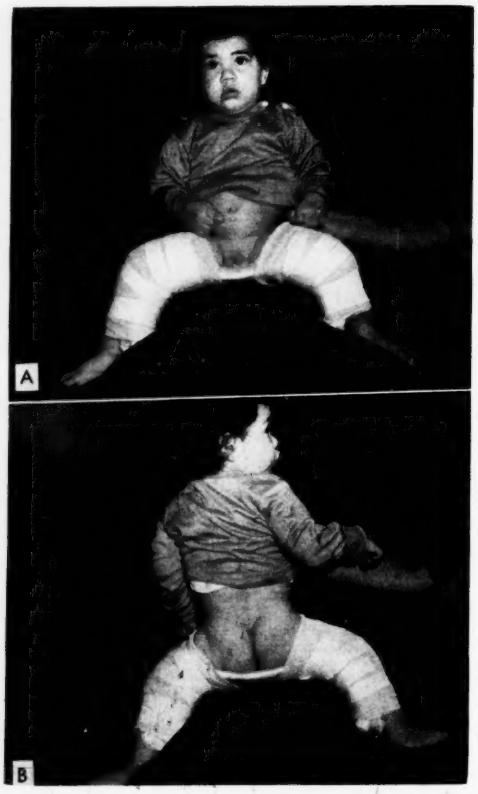

Fig. 3.—Lower extremities bound to frame with bias cut stockinette bandages. The skin of the pubic, perineal and gluteal areas can be easily cared for.

Fig. 4.—Roentgenogram taken with the frame in position.

portion of the long side is depressed toward the center of the frame and away from the pubic and perineal regions. The wire rungs are bent toward the center of the frame so that they are slightly concave at the side of contact with the extremities (Fig. 1, *A* and *B*). It is best to start with a longer piece of splint, because if the short sides are too long they can be easily trimmed with wire cutters. The length of the long side can be gauged by the distance between the areas of the cast that correspond to the popliteal regions. Several layers of sheet wadding are wrapped around the frame for padding, and the appliance is made moisture-proof by covering it with oiled silk (Fig. 2, *A* and *B*).

The frame is then placed between the abducted and flexed thighs. There is contact between the posterior surfaces of the thighs and legs from the ischial tuberosities down to 1½ inches (3.7 cm.) above the ankle. The thighs and legs are bound to the frame by bias cut stockinette bandages. The pubic and perineal regions clear the depressed portion of the top of the frame by 1 to 1½ inches (2.5 to 3.7 cm.), and one has no difficulty in keeping these parts clean by frequent changes of diaper. The abdomen, pubic, perineal, gluteal and low back areas are entirely free of any kind of covering, and the skin can be well cared for by exposure to air, the use of corn starch powder and whatever applications are indicated.

The child can be picked up and frequently turned from a supine to a prone position (Fig. 3, *A* and *B*). The lower extremities can be cleaned by removing the bandages from one leg at a time. An aide holds the leg in a flexed and abducted position, and with the frame pushed to the other side (which will increase the abduction of the opposite thigh), the skin is accessible everywhere. The frame allows for a few degrees of flexion extension movements in the hip joints, but abduction is always maintained (Fig. 4). As compared with a spreader bar, it has the advantage that no strain is put on the knee joints. It has the disadvantage that

more care is required on the part of the mother or nurse.

SUMMARY

A simple frame is described for temporary use in the treatment of congenital dislocation of the hip. It is cheap and quickly improvised and offers continued maintenance of the frogleg position when plaster of paris cannot be used on account of poor condition of the skin or an intercurrent disease. It is an expedient device, but in some cases, because of inadequate attention to sanitary requirements at home, it has been substituted for the plaster of paris cast.

RESUMEN

Se describe un cuadro simple para uso temporal en el tratamiento de la dislocación congénita de la cadera. Es barato y facilmente improvisable y ofrece mantenimiento continuo de la posición en pierna de rana cuando no puede usarse enyesado a causa de la condición de la piel ó padecimientos asociados. Es una idea apropiada, pero en algunos casos a causa de la atención inadecuada de los requerimientos higiénicos hogareños ha sido substituído por los enyesados.

ZUSAMMENFASSUNG

Es wird ein einfacher Rahmen zur vorübergehenden Verwendung in der Behandlung angeborener Hüftgelenksverrenkungen beschrieben. Der Rahmen ist billig, lässt sich schnell und ohne Vorbereitungen herstellen und ermöglicht die ständige Erhaltung der Froschschenkelstellung, wenn Gipsverbände wegen schlechter Beschaffenheit der Haut oder wegen interkurrenter Erkankungen nicht angewandt werden können. Der Apparat ist praktisch, musste aber in manchen Fällen wegen ungenügender Beachtung der sanitären Vorschriften im Hause des Kranken durch Gipsverbände ersetzt werden.

RÉSUMÉ

L'auteur décrit une attelle pour le traitement de la luxation congénitale de la hanche. Elle revient à bon marché et peut être rapidement improvisée; elle maintient le sujet en position classique, dans les cas où on ne peut pas utiliser le plâtre de Jaris par suite du mauvais état de la peau ou de maladie les conditions d'hygiène n'étant pas satisfaisantes quand le malade est soigné à domicile, on a utilisé le plâtre de Paris.

RIASSUNTO

Viene descritto un dispositivo semplice di uso temporaneo nella cura della lussazione congenita dell'anca. E' economico, facilmente procurabile e consente di mantenere le anche divaricate fino a che non si possa fare l'apparecchio gessato, per particolari ragioni.

E' un apparecchio di grande utilità in casi particolari.

Obstinacy and heat in argument are surest proofs of folly. Is there anything so stubborn, obstinate, disdainful, contemplative, grave, serious, as an ass?

—*Montaigne*

Section on Ophthalmology and Otorhinolaryngology

PAUL C. CRAIG, M.D., F.A.C.S., F.I.C.S., EDITOR

Acoustic Trauma: A Clinical and Laboratory Study

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IN the year 1883 there occurred in the Straits of Sunda between the island of Java and the island of Sumatra, a natural catastrophe which was probably the greatest in recorded history. The volcano Krakatau erupted. Thirty thousand persons were killed by the explosion, its gases, its fiery lava, its tidal wave and its earthquakes. As an unimportant by-product of this eruption there was created a tremendous noise. It has been said that the noise of the volcano in the Sunda Straits was heard thousands of miles away in Australia. This was the loudest sound produced in historical times.

Disasters like eruptions of volcanos are extremely rare and do not constitute any particular danger to the ear. Thunder, heavy storms and other noises of nature, like waterfalls and surf, are not severe enough, not of sufficient duration and not abrupt enough to be harmful to the ear.

Acoustic trauma, as the term is here used, is a by-product of modern industrial civilization and of total warfare. One can define acoustic trauma as an injury to the ear caused by sound. It has been known in a general way for the past hundred years that excessive noise is harmful to the ear. It is only during the past ten or fifteen years, however, that increased interest has been created and active preventive measures taken. To a certain extent the reasons for increased interest are medicolegal. Some state legislatures have enacted statutes that make industrial noise a compensable disability. It can be expected that many workmen will file claims for compensation. If this happens, or, rather, since it has already begun to happen, industry, insurance companies, labor and, last though not least, the otologist must take an increased interest in acoustic trauma.

The problem of industrial noise and the acoustic problems of modern warfare are only in their initial phase. This is the age of jet engines. A few observations have been made that demonstrate the harmful effect of jet engines. More powerful jet machinery will be put in commission, and therefore increased otologic problems will be created. The noise levels of jet engines are enormous. The sound pressures may become so high that all tissues of the body execute mechanical vibrations of large amplitude. It is not known at this time what nonauditory problems, perhaps pertaining to the vestibularis or to the brain matter in general, will become important when more jets come into use.

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It is obvious, therefore, that the otologist must be thoroughly interested in and fully informed about the many physical, physiologic, audiologic, pathologic and medicolegal aspects of acoustic trauma.

Two main types of damage to the ear can be distinguished (1) the effect of air blasts, e. g., detonations, gunfire and bomb explosions, and (2) the effect of sustained stimulation of high intensity—industrial noise as heard in machine shops, steel mills, weaving mills, forges and the like.

Parallel to but not identical with these two causes of ear damage are two types of damage in the ear: (a) a physical destruction of the sound conduction system, caused by traumatic bursting of the eardrum or round window membrane with fractures of the ossicles and hemorrhages, and (b) slow degeneration of the neurosensory structures in the inner ear. Hair cells, nerve fibers, and ganglion cells in the cochlear ganglion may be affected and may degenerate; like old soldiers, they just fade away.

The first step in effective abatement of industrial noise is the recognition of its importance. The second step is the planning of effective teamwork between management, industrial engineers, tool designers, safety directors, acoustic consultants and otologists. Certain machinery can be designed so as to make less noise in operation; other types can be shielded, and some performances can be executed without an operator present or near by. Many individual solutions can be found if there is only the will to find them.

Workers can wear a plug in the ear, which offers a certain although limited protection. The best ear plugs attenuate sound by 30 to 35 decibels. But it should be kept in mind that even the best plug does not function properly if it is not placed correctly in the ear canal.

It is important to ascertain the hearing ability of the worker before he begins his work. If he becomes deaf after working in a noisy place, the comparison of his hearing with the pre-employment examination will provide a yardstick to measure the hearing impairment caused by the industrial noise. Too many workers still are employed without a pre-employment audiogram. The result is that any later claim cannot be clearly interpreted.

More information is necessary to assess the natural aging of the human ear. Suppose a 60-year-old worker, after twenty-five years of service in a drop forge, files a claim on account of hearing impairment. His interpretation is that his hearing is diminished because of his work in the shop for twenty-five years. In reality at least two factors, if not more, cause the hearing impairment. Granted, the high noise level has damaged his ear, but in addition he has become twenty-five years older in the meantime. It is common knowledge that the hearing diminishes with advancing age. It is not possible by existing clinical and audiological methods to distinguish which percentage of the hearing impairment is caused by age, which acquired by disease or hereditary factors and which by noise.

Otologic science is simply not advanced enough to provide the answers to these important questions. Since it is the aim of the profession that just and equitable decisions be made by the industrial commission, otologic science must take steps to study these problems by intensive laboratory investigation. One does not wish to see a worker denied a justified claim because the otologist failed in diagnosis, nor does one like to see an insurance company pay compensation for a hereditary deafness that happens to be indistinguishable from acoustic trauma.

Thorough knowledge of the morphologic and physiologic aspects of the ear is a prerequisite to the study of acoustic trauma. Acoustic overloading is a physical problem. It deals with maximum stimulation and maximal responses of the human ear. A knowledge of the construction materials of the human ear, and of its tolerance, is important.

Unfortunately the ear is small; its structures are hidden deep in the skull, and, last but not least, acoustic phenomena

take place very rapidly. It is possible, nevertheless, to overcome the technical difficulties and to record optically what happens in the ear. The motion picture camera has proved to be an excellent scientific tool for recording the physiologic acoustic phenomena in the ear during acoustic trauma. Laboratory tests have been carried out in which the elastic forces and the breaking point were tested. In addition, the ears of experimental animals were exposed to detonations. With the high speed motion picture camera (4,000 frames per second) cinematographic recordings were made of the ear during blasts. The sharp abruptness of the airblast and the excessive oscillations of the ear could be observed and measured. On certain occasions one could observe perforation of the eardrum and fracture of the ossicles. Other detonations, which were smaller or occurred at a greater distance, did not destroy the sound conduction system.

Sustained loud noises like those occurring in industry hardly ever destroy the sound conduction system physically. Large vibrations are carried out by the ossicles, but in most cases there is no visible physical damage seen in the middle ear. (Film demonstration of sound conduction system during maximum stimulation by sustained noise.)

The damage in the inner ear is only microscopic. Certain cell groups, e. g., the hair cells, degenerate; the nerve fibers and ganglion cells are affected in more severe cases, and finally the whole organ of Corti is destroyed.

The ear possesses a series of protective devices against excessive sound, the most important of which is the acoustic reflex of the middle ear muscles. These muscles contract on acoustic stimulation.

No effective treatment is possible once acoustic trauma has taken place and the nerve structures of the inner ear have been destroyed. All-important, therefore, is the *prevention* of acoustic trauma in the cochlea.

A practical solution for industry is well within the realm of possibilities. The otologist who acquires a knowledge of acoustic trauma and an interest in its prevention will be a better leader in his community, because he can furnish information and advice with regard to noise problems and noise protection.

SUMMARY

Acoustic trauma is a man-made problem. Nature has no sound sources that damage the ear. But industrial and military conditions expose the human ear to sound intensities for which it is not made, for which it is not prepared and against which it is not protected.

More members of the armed forces are being exposed to explosions and gunfire and to loud sustained noises by airplane motors, jet engines, diesel engines and other noise-producing equipment. In industry, potential dangers to hearing arise from sustained excessive noises of machinery. The noises of the "jet age" pose a problem that is not yet clearly understood. Immediate laboratory and clinical observation are needed.

Through the use of a high speed motion picture camera, recordings have been made of the ears of experimental animals exposed to detonations. Rupture of the eardrum and fracture of the tiny bones inside were observed.

The ear possesses a series of protective devices against excessive sound. The most important protection is the acoustic reflex of the middle ear muscles, which contract on acoustic stimulation. No effective treatment is possible once acoustic trauma has taken place and the nerve structures of the inner ear have been destroyed. It is therefore all-important to prevent acoustic trauma in the cochlea. A practical solution for industry is well within the realm of possibilities. Construction of less noisy machinery will help overcome this serious industrial hazard.

ZUSAMMENFASSUNG

Schallverletzungen sind vom Menschen

geschaffene Probleme. Die Natur kennt Schallquellen, die das Ohr verletzen. Die Verhältnisse in der Industrie und im Heereswesen jedoch setzen das menschliche Ohr Schallstärken aus, für deren Aufnahme es nicht geschaffen ist, auf die es nicht vorbereitet ist, und vor denen es nicht geschützt ist.

Eine ständig wachsende Zahl von Angehörigen der Wehrmacht ist Explosionen, Gewehrschüssen und den Geräuschen von Flugzeugmotoren, Jetmaschinen, Dieselmotoren und anderen lärmerzeugenden Apparaten ausgesetzt. In der Industrie ist das Ohr den Gefahren, die in den übermässigen Geräuschen der Maschinen liegen, ausgesetzt. Der Lärm des "Jet-Zeitalters" ist ein Problem, das noch nicht volles Verständnis gefunden hat. Unverzügliche Laboratoriumsuntersuchungen und klinische Studien sind notwendig.

Mit Hilfe von Filmkameras mit grosser Geschwindigkeit sind Aufnahmen vom Ohr von Versuchstieren, die Explosionen ausgesetzt wurden, gemacht worden. Zerreissungen des Trommelfells und Brüche der Gehörknöchelchen wurden beobachtet.

Das Ohr besitzt eine Reihe von Schutzvorrichtungen gegen übermässige Geräusche. Der wichtigste Schutz besteht im Akustikusreflex der Muskeln des Mittelohres, die sich auf akustischen Reiz zusammenziehen. Hat eine Verletzung des Akustikus einmal stattgefunden, und sind die Nervengebilde des inneren Ohres einmal zerstört, gibt es keine wirksame Behandlung mehr. Daher ist es von überragender Wichtigkeit, akustische Verletzungen in der Schnecke zu verhüten. In der Industrie liegen praktische Lösungen des Problems durchaus im Bereiche der Möglichkeiten. Die Konstruktion weniger geräuschvoller Maschinen kann dazu beitragen dieses schwere industrielle Risiko zu vermeiden.

RESUMEN

El trauma acústico es un problema producido por el hombre. La naturaleza no tiene fuentes de sonido que lesionen al oído. Contrariamente, las condiciones industriales y militares exponen al oído humano a intensidades de sonido para las cuales dicho órgano no ha sido hecho, para las cuales no esta preparado y contra las cuales no esta protegido.

La mayoría de los miembros de las fuerzas armadas han sido sometidos a explosiones de armas de fuego y sonidos sostenidos bajos, tales como los producidos por motores de aeroplanos, de propulsión a chorro, diesel y otras maquinas productoras de sonido. En la industria los poligros potenciales para la audición se producen por ruidos excesivos y sostenidos. Los ruidos de la "edad de la propulsión a chorro" plantean un problema que no es entendido claramente, requiriéndose observaciones de laboratorio y clínicas inmediatas.

A traves del uso de camaras cinematográficas de alta rapidez cinética, se han obtenido registros de los oidos de animales experimentales expuestos a detonaciones. Se observaron rupturas del tímpano y fractura de los huesos del oído medio.

El oído posee una serie de mecanismos protectores contra el sonido excesivo. La protección más importante es el reflejo acústico de los músculos del oído medio que se contraen bajo la estimulación acústica. No existe un tratamiento efectivo posible una vez que se ha producido el trauma acústico y que se han destrùido las estructuras nerviosas del oído interno. Es por lo tanto importante, el prevenir el trauma acústico en la coclea. En la industria está a alcance posible una solución prática. La construcción de maquinas menos ruidosas, ayudaría a contrarestar los graves peligros de la industria.

SUMÁRIO

O trauma acústico constitute problema produzido pelo homem. A natureza não possue fontes de som que lesem o ouvido. Mas as condições industriais e militares expõem o ouvido humano à intensidades de som, para as quais não está adaptado, preparado: e, contra as quais não está protegido.

Maior número de membros das forçadas

estão sendo expostos a explosões, tiros e ruídos fortes produzidos por motores de aereoplanos, máquinas a jato, máquinas diesel e outros maquinários. Na indústria, os perigos potenciais da audição se originam pelos ruídos excessivos do maquinário. Os ruídos da "idade do jato" oferecem um problema que ainda não foi claramente compreendido. As observações clínica e de laboratório, imediatas, são necessárias.

Pelo uso de uma câmara cinematográfica de alta velocidade, têm sido feito registros dos ouvidos de animais experimentalmente expostos a detonações. Ruptura do timpano e fratura de pequenos ossículos no seu interior foram observados.

O ouvido possue uma série de artifícios protetores contra o som em excesso. A proteção mais importante é o reflexo acústico dos músculos do ouvido médio, que se contraem sob estímulo acústico. Nenhum tratamento eficaz é possível uma vez que tenha ocorrido trauma acústico e as estruturas nervosas do ouvido interno tenham sido destruidas. Portanto, é muito importante impedir o trauma acústico na cóclea. Uma solução prática para a indústria está incluida no âmbito das possibilidades. A construção de maquinário mais silencioso auxiliará a vencer êste sério risco industrial.

RIASSUNTO

Il trauma acustico è un problema creato dall'uomo, dacchè in natura non esistono rumori che possano offendere l'udito. L'orecchio non è fatto per la intensità dei rumori prodotti dalle industrie o dalla guerra. I soldati sono esposti alle esplosioni, agl scoppi delle armi da fuoco, ai rumori dei motori di aereoplano, dei reattori, dei motori diesel e degli altri meccanismi rumorosi. Gli operai dell'industria possono avere danni all'udito per i rumori delle macchine. Il chiasso dell' "età del reattore" crea un problema nuovo, non ancora affrontato e che merita uno studio immediato. Sono state studiate le orecchie di animali da esperimento esposti a detonazioni, usando una macchina da ripresa ad alta velocità. Si osservarono rotture della membrana e delle ossicine. L'orecchio possiede una serie di dispositivi di protezione contro i rumori eccessivi, fra cui, il più importante, il riflesso acustico dei muscoli dell'orecchio medio che si contraggono ad ogni stimolo. Non è più possibile alcuna cura dal momento in cui si è stabilito il trauma acustico e sono state distrutte le strutture nervose dell'orecchio interno.

Genius is a cruel disease. Every writer carries a canker in his heart, a devouring monster, like the tapeworm in the stomach, which destroys all feeling as it arises in him. Which is the stronger? The man or the disease? One had need to be a great man, truly, to keep the balance between genius and character. The talent grows, the heart withers. Unless a man is a giant, unless he has the thews of Hercules, he must be content either to lose his gift or to live without a heart.

—*Balzac*

Editorial

The Use of the Cobalt 60 Unit

SINCE 1925, when Coolidge first produced a sealed off tube operating at 300 Kv., there has been an accelerating interest in the therapeutic use of higher voltage roentgen apparatus. By 1933, a few very high voltage roentgen machines were available — Lauristsen's multi-section tube at Pasadena, which operated at 1,000 Kv., and a Coolidge cascade type tube of 700 Kv. at the New York Memorial Hospital. These machines, however, were mechanically not reliable enough for sustained clinical trial. Since 1936, supervoltage roentgen tubes have been produced in great variety, but it is only in the last few years that they have come into anything approaching routine clinical use. Roentgen rays of the order of 1,000,000 to 2,000,000 volts can now be considered to have passed the experimental stage, and undoubtedly supervoltage machines of this range will be widely distributed in the near future.

The careful and conservative prolonged clinical trials of Phillips[1] in London and Cantril and Buschke[2] in Seattle have done much to bring this situation about. A number of roentgen machines operating at energies of 1,000,000 to 2,000,000 volts are now scattered over the North American Continent and Europe. These machines are in more or less routine clinical use, and there is little doubt that they are proving superior to conventional roentgen machines in certain types of cases. Still in the experimental stage are linear accelerators and betatrons with energies ranging from 10,000,000 to 70,000,000 volts.

A more recent development has been the production of useful treatment units containing very large quantities of cobalt 60. These units can be considered roentgen machines of approximately 3,000,000 volts, since the gamma rays produced have similar properties.

Many of the older radiotherapists have considered the gamma rays of radium superior to conventional roentgen rays in the treatment of cancer. This impression has probably been fostered by the fact that radium in the form of radium implantation is much more suitable in the treatment of cancer in certain situations than is roentgen therapy. For instance, in the mouth, it is possible by a suitable implant to deliver a very high dose to a small volume and thereby to confine the effect of radiation to a small portion of the mouth. It is not possible to achieve this effect by external irradiation, and treatment with radium is therefore more likely to be successful. Furthermore, the comparison of radium treatment and roentgen treatment is difficult, since the dosage is different in each case. Radium is usually applied continuously over a period of days or for a large number of hours each day for several days, whereas roentgen treatment is usually employed in the form of brief daily exposures. There are really very few grounds for the belief that gamma rays of radium have a different biological effect as compared with roentgen rays, and this has been demonstrated effectively by Wood.[3] It is generally agreed that the biological effect of all radiations is produced by ionization in the tissues, and each ion is the same, whatever type of radiation produces it. There is some difference,

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1. Phillips, R.: Super-voltage Therapy. H. K. Lewis & Co., 1947.

2. Buschke, and Cantril: Super-voltage Roentgen Therapy. Springfield, Ill.: Charles C Thomas, Publisher.

3. Wood, C.: Report No. 267, Medical Research Council H.M. Stationery Office, London, 1950.

however, in the spatial relation of the ionization produced by gamma rays as compared with conventional roentgen rays. For instance, in the path of a single photon produced at 200 Kv. through tissues, the average number of ions produced per micron is 55, as compared with 8.3 for 3 m.e.v. radiation, and 6.7 for 23,000,000 volts.[4] It is just possible that this change in mean linear ion density may produce different biological effects, since the lower the mean linear ion density the more evenly distributed throughout the different parts of each cell will be the ionization. It is therefore possible that there is more chance of a true differential effect between normal and malignant cells.

The radiations produced at energies of 1,000,000 to 4,000,000 volts, or with Cobalt 60, are similar physically to the gamma rays of radium. The mean linear ion density is about the same. Their great advantage over radium is that they can be directed at a patient from a greater distance because a very high output can be obtained, and therefore the inverse square law can, to a large extent, be overcome, permitting much higher percentage depth doses.

In August 1951, a 1,000-curie Cobalt 60 source was obtained by the Saskatchewan Cancer Commission from the Canadian Atomic Energy Project at Chalk River and installed in a locally designed and built unit at the University Hospital, Saskatoon. The machine has been in continuous clinical use since November 1951. The unit consists essentially of a lead-filled steel sphere, inside which is mounted a wheel that can be rotated 180 degrees by an electric motor. Set into the periphery of the wheel is the radioactive cobalt source, consisting of twenty-five discs, each 2.5 cm. in diameter and 0.5 mm. thick, and arranged in the form of a cylinder 1.2 cm. high. When the wheel is rotated to the "on" position the cobalt can "see" the exterior through a hole in the lead sphere. By means of a collimating apparatus and cones, beams of various sizes can be obtained. When the wheel is rotated 180 degrees the cobalt is shielded by a tungsten alloy plug in the wheel, and no significant radiation escapes. Various accessory equipment can be mounted on the head[5] for accurate beam direction. The whole apparatus, weighing about a ton, is suspended from overhead rails by a central column. It can be moved backward and forward, up and down, and rotated by electric motors controlled by a box of push-buttons held in one hand. Under the machine there is a circular section of the floor that can be made to rotate at varying speeds by an electric motor. The control panel is very simple; it consists merely of an electric timing clock which rotates the wheel to the "on" position and automatically rotates it "off" when the desired exposure is given. A series of interlocks prevents the machine from operating when the door to the treatment room is open. Further details of construction may be found elsewhere.[6] Since the moving parts are few and simple, no costly repairs or replacements are required. The Cobalt 60 has a "half-life" of a little over five years, and hence has to be replaced when the output becomes too low for practical use.

With conventional roentgen rays, when a large volume is irradiated, there is always a hazard of radiation sickness and leukopenia. This effect is due to absorption by the body as a whole of a large amount of radiation. When a similar volume is treated with supervoltage irradiation, however, to the same dose, the absorption of radiation of the body as a whole is considerably reduced—in some instances to only a third or a half.[4] This difference is achieved because supervoltage

4. Watson, T. A.; Johns, H. E., and Burkell, C. C.: The Saskatchewan 1000 Curie Cobalt 60 Unit, Am. J. Roentgenol. & Rad. Therapy, to be published.

5. Watson, T. A.: The Clinical Possibilities of the Cobalt 60 Beam Unit, J. Canad. A. Radiologists 3:7, 1952.

6. (a) Johns, H. E.; Bates, L. M., and Watson, T. A.: The Saskatchewan Cobalt 60 Unit, Brit. J. Radiol. 25:296, 1952.

6. (b) Burkell, C. C.; Watson, T. A.; Johns, H. E., and Horsley, R.: Skin Effects of Cobalt 60 Telecurie Therapy, Brit. J. Radiol., to be published.

radiation tends to be confined to the geometric beam and very little side-scatter occurs. With the use of similar technics in treating large volumes of tissue, radiation sickness will be less likely to occur with supervoltage therapy.

An important advantage of supervoltage irradiation is the great penetrating power of the rays. The percentage dose reaching a deep tumor is very much higher than with conventional roentgen rays.[7]

In general, with conventional roentgen irradiation, the dose is at a maximum where it strikes the surface of the body, and thereafter falls slowly. With the supervoltage machine, however, the dose does not reach a maximum till it penetrates some distance below the surface of the skin. This distance depends on the energy of the radiation. For instance—with roentgen rays of 2,000,000 volts it is about 3 or 4 mm., while with cobalt irradiation,[8] it is 5 mm.; and with even higher energy machines, such as the 23,000,000 electron volt betatron, the 100 per cent level is not reached before penetration to a depth of 4 cm. It is, therefore, obvious that cutaneous reactions for similar incident doses will be very much less with supervoltage roentgen rays than with the usual kind. My co-workers and I have shown[6b] that, if one interposes unit density material of varying thicknesses between the applicator end and the skin, this physical factor is of very great importance in the production of milk skin effects. A further factor lessening the skin effect of these rays is that elements in the skin, such as sulphur, do not contribute nearly as much secondary radiation as with low voltage roentgen rays. The skin-sparing effect is of considerable importance in routine clinical use, but it must be remembered that when a deep tumor is being treated by irradiation of any kind, it is the dose actually received by the tumor and its immediate vicinity that is important. The effect on the skin gives no indication whatsoever of the dose received by the tumor.

A further physical consideration that is valuable in therapy is that high voltage rays are absorbed more nearly equally by bone, cartilage, and soft tissues than are low voltage roentgen rays.[4] With the latter, bone will absorb several times as much energy as will the surrounding soft tissue, and therefore necrosis of bone or cartilage is more likely to develop at the lower energy levels. Examples of this are cartilage necrosis in the treatment of cancer of the larynx, bone necrosis in the treatment of tumors about the jaw, or fractures of the neck of the femur in the post-radium roentgen treatment of cancer of the uterine cervix.

The indications for the use of high voltage therapy follow logically from these various physical advantages. It is obvious that the high percentage depth dose and the comparatively low integral dose are particularly applicable to the treatment of deep-seated tumors. By the use of a few cross-firing beams very high tumor doses can be obtained, with simultaneously low skin doses. The cutaneous reaction is further reduced by the lesser skin effect of the incident high energy roentgen rays.

These advantages may be further enhanced by the employment of rotational technics,[9] by which the roentgen beam is continuously directed at the tumor while the patient is rotated. The beam, therefore, while always striking the tumor, enters the body through a constantly changing skin surface. By offsetting the center of rotation, volumes of tissue of various shapes and sizes (e.g., the chest wall and the axilla in cases of inoperable carcinoma

7. (a) Johns, H. E.; Darby, E. K.; Watson, T. A., and Burkell, C. C.: Comparison of Dosage Distributions with 400 K.V.P. x-rays and 22 m.e.v. x-rays, Brit. J. Radiol. 22:290, 1950.

7. (b) Johns, H. E.: Physical Characteristics of the Radiation in Cobalt 60 Beam Therapy, J. Canad. A. Radiol. 3:2, 1952. Watson et al.[4] Johns et al.[6a]

8. Watson et al.[4] Johns.[7b]

9. (a) Stapleton, J. E.: Treatment of Advanced Carcinoma of the Bladder with Two Million-volt Rotation Therapy, J. Faculty of Radiol. 4:207, 1953. (b) Wheatly, B. M.; Steed, P. R.; Savage, E. W.; King, J. H.; Forster, E. W.; Hodt, H. J.; Jones, I. B., and Smithers, D. W.: The Two Million Volt Van DeGraff Generator Installation Designed for Rotation Therapy at the Royal Cancer Hospital, Brit. J. Radiol. 26:57, 1953.

of the breast) can be irradiated homogeneously without undue exposure of surrounding normal structures—the so-called "scanning" technic.[10]

Carcinoma of the esophagus, because of its deep situation, is better treated by high-energy roentgen rays than by conventional ones, as is inoperable carcinoma of the lung, in which useful palliation can sometimes be obtained. Large infiltrating tumors of the bladder[11] can be resolved with reasonable frequency. Good palliative results have been reported in the treatment of inoperable carcinoma of the rectum.[1]

Secondary deposits in bone are probably better treated by supervoltage roentgen rays, because the differential absorption of bone is less than with rays of lower voltage. Although conventional roentgen rays are absorbed more by bone than by soft tissues, this extra dose in confined to the hard bone only, and the increased secondary electrons do not penetrate more than a few microns into the bone spaces.[12a]

Carcinoma of the larynx or pharynx should respond better to supervoltage therapy, since the hazard of cartilage necrosis is less.

Although cutaneous reactions, for the physical reasons previously mentioned, are much less severe, my experience has shown that, for the same tumor dose, mucosal and tissue reactions are practically the same as those produced by 400 Kv. roentgen rays. This treatment cannot be undertaken lightly. When there is a possibility of eradicating a tumor the treatment, like the operation, must often be "radical." By this I mean that considerable physical calculation involving the construction of isodose distributions for each patient must frequently be made. Every effort, often involving the construction of individual plaster casts, must also be made to direct each field accurately, so that the volume of irradiated tissue is reduced to a minimum, and deep tumors must be localized to obtain optimal results. The continuous collaboration of radiation physicists is essential.

It should be emphasized that no new principles are involved in the use of the Cobalt 60 unit. The great publicity accorded it in popular magazines and newspaper articles is to be deplored, and arises from a misapprehension of the factors involved. It has been pointed out that the rays produced are very similar to those produced by 1-3 m.e.v. roentgen ray machines, which have been in use for some years, and one cannot say, therefore, that a new "cure" for cancer has been found. The most that can be claimed is that some radiotherapeutic technics can be extended and made more effective by the use of these high energy roentgen rays.

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10. Trump, J. G., and Webster, E. W.: Rotational Scanning of Breast Malignancies with Super-voltage Radiation. Am. J. Roentgenol., Rad. Therapy and Nucl. Med. 68:35, 1953.

11. (a) Watson, T. A., and Burkell, C. C.: The Betatron in Cancer Therapy, J. Canad. A. Radiol. 2:60, 1951; ibid. 3:25, 1952.

11 (b) Stapleton.[9a] Wheatley and others.[9b]

12. (a) Spiers, F.: The Influence of Energy Absorption and Electron Range on Dosage in Irradiated Bone, Brit. J. Radiol. 22:521, 1949. (b) Johns, H. E.; Epp, E. R.; Cormack, D. V., and Fedoruk, S. O.: Depth Dose Data and Diaphragm Design for the Saskatchewan 1000 Curie Cobalt Unit, Brit. J. Radiol. 25:302, 1952.

The highest form of vanity is love of fame. It is a passion easy to deride but hard to understand, and in men who live at all by imagination almost impossible to eradicate.

—*Santayana*

New Books

Studies on Renal Colic and Its Treatment by Posterior Splanchnic Block. By Lars Risholm. Acta Chirurgica Scandinavica; Supplement 184, 1954. 12 illustrations, complete Bibliography. 64 pages.

This treatise on renal colic deals first with a survey of the literature on the mechanism of this disease, after which the author describes his own experimental work on the production of renal colic in human subjects. The condition was produced through obstruction of the ureter by means of a bag catheter and observation and recording of the intravesical pressure and the sensation of pain at various ureteral levels.

He concludes that local increase in intraureteral pressure with distension of the wall does not always produce pain, but that increased pressure in the renal pelvis is the essential cause of renal colic. Hypoperistalsis of the ureter is present; thus, peristalsis of the ureter is present; thus, peristalsis of the ureter is not significant in the production of renal colic.

The technic of posterior splanchnic block is adequately described, and its advantages over paravertebral block are enumerated: it is easier to perform, it is less unpleasant for the patient, and only one injection is needed. No toxic effects are noted, and in some cases the response is used in the differential diagnosis of pain in other abdominal viscera.

The author used this treatment in 51 cases. All of the patients were quickly relieved of pain. In 13 the pain did not recur. In 5 the colic returned in twenty-four hours. In 33 pain recurred in two or three hours. Splanchnic block was repeated once or twice in 11 of these. No complications from the procedure were reported. It had no influence on the urinary flow, or on ureteral peristalsis to facilitate the passage of the calculus.

Peptic Ulcer. By C. F. W. Illingworth. Edinburgh and London: E. & S. Livingstone, Ltd., 1953. Pp. 287.

This book presents an extensive study of the peptic ulcer and of the ulcer problem generally. The author discusses extensively the physiologic nature of gastric secretion and gives a brief review of the blood supply. A brief statistical review leads to the chapters on etiology, clinical symptoms, treatment and complications.

The author is fair in discussing viewpoints with which he does not agree. He rejects simple vagotomy and favors vagotomy and gastroenteroanastomosis or resection. The book is up to date on the research of the last few years, although, in the chapter on perforation, the author should have discussed the danger of perforation in cortisone treatment. Each chapter is followed by a brief bibliographic index. All in all, the book is a comprehensive and worth while addition to the literature on peptic ulcer and should be of great interest to the internist and the surgeon.

WERNER F. EISENSTAEDT, M.D.

Mastopathie und Milchdrüsenkrebs . . . zugleich zweite umgearbeitete und ergänzte Auflage von Pathologie, Klinik und Behandlung der Mastopathie. By George E. Konjetzny. Stuttgart: Ferdinand Enke, Verlag, 1954. Pp. 140. Illustrated.

When Konjetzny, one of the leading figures of the contemporary surgical world, decided to issue a review and evaluation of the whole problem of mastopathic conditions in the female, after twenty-five years' experience with this important question, it was an event of first importance.

The first edition of Konjetzny's *Mastopathie* appeared in 1942. Neither its modest form of publication nor the author's personal modesty concealed in the least the significance of the book, which was devoured and redevoured by those of his admirers who had access to it. This edition has been out of print for some time.

The second and revised edition takes on extra importance for several reasons. For one, it is possible that the original contribution, appearing at a time of world stress, could most easily escape the attention of surgeons living outside Germany and not in intimate touch with the medical press of that nation.

Largely this is a faithful reissue of the former edition, and most of the original text is repeated *verbatim*. There is some slight abridgement of this material, and some unessential plates have been omitted.

The changes and additions are most significantly mirrored in the altered title, with its primary emphasis on the mastopathy-cancer relation. This was stressed as an essential topic of the earlier edition. Ten additional years have led the author to the conclusion that it is the central problem.

It has also been possible to reorganize the contents in somewhat more logical order, and thus make room for additional theoretical material at the beginning. The result is a more rounded treatise, with separate sections on pathology, histology, and etiology—a treatise that can now serve as a useful handbook for the practicing physician. The discussions on anamnesis, diagnosis and clinical material have also been combined into one clinical section. Place is also made for additional and more recent clinical evidence and citations from more recent contributors.

General surgeons who can take advantage of the German will recognize here one of the most mature and compact evaluations yet seen concerning a problem that faces us daily.

The scope of the book can be judged from its contents by chapter: I. Introduction. II. History of Mastopathy. III. Pathological Anatomy. IV. Histology of Mastopathy. V. Etiology of Mastopathy. VI. Clinical Material: Frequency of Mastopathy, Mastopathy in which Woman? Age, Race, Previous History, Pain, Pathological Secretion, Palpation, Diagnostic Operation. VII. Mastopathy and Carcinoma: Frequency, Special Cases, Association of Mammary Carcinoma and Mastopathy. VIII. Treatment of Mastopathy: Hormonal, Undesirable Side-effects of Hormone Treatment, Roentgen, Spontaneous Recovery and Recovery Following Gynecological Operation, Surgical, Summary of Surgical Treatment. Bibliography.

In his final pages, Konjetzny adds emphasis to his earlier statement on the limitations and the highly individual conditions for successful surgical treatment. Operation should not be unnecessarily extensive, and radical operation should be based on compelling grounds only. The situation is one, however, in which the treatment is not easily standardized but depends essentially on the individual case. At present, the author points out, there is no simple scheme of indications adequate to the great variation that mastopathic conditions actually present. Faced with a choice of procedures, the surgeon in this field must therefore be much more than an expert technician. He must also become an expert in diagnostics, symptomatalogy and pathology, if he is to find his way to the correct treatment.

MAX THOREK, M.D.

Intratracheal Intubation in Anesthesia. By Henri Gilbert. Paris: G. Doin et Cie., 1953. Pp. 199, with 39 illustrations.

This monograph describes clearly the anatomic structure of the respiratory tract, including the oral and nasal cavities, the larynx and the trachea, knowledge of which is of importance in endotracheal intubation. In addition, it covers the most common abnormalities and pathological changes which may create difficulties in or even make it impossible to perform intubation. Dr. Gilbert stresses the value of indirect laryngoscopic study in the preoperative examination of the patient so that the intubation may be safe, atraumatic and rapid. When nasal intubation is contemplated, examination of the nasal cavities and epipharynx is essential.

A complete step-by-step description of the technic of direct and "blind" nasal intubation is presented, with emphasis on the dangers, difficulties and possible false routes, as well as the complications that may occur during and after the procedure. Separate chapters deal with the route for intubation (oral or nasal), the problem of aspiration, the technic of extubation and, briefly, the management of anesthesia in the intubated patient with various agents. The author indicates the absolute and relative indications for intubation, which depend on the presence of an emergency situation, the type of surgical operation proposed and the requirements during anesthesia to insure safety for the patient and adequate working conditions for the surgeon. A brief review of the problems of respiration, together with a list of contraindications to intubation, concludes the work.

This book is a valuable addition to the literature on intubation. An improvement would have been the use of colored rather than black-and-white drawings.

H. CHIARI, M.D.

1954 Medical Progress: A Review of Medical Advances During 1953. Edited by Morris Fishbein. New York: The Blakiston Co., 1954. Pp. 345.

With the appearance of the second volume of this new series, one is gratified to note

that one's original evaluation seems fully justified. The concept which holds that a book-length survey is useful and welcome to practitioners and allied medical scientists is a sound one. The editors have again done a first-rate job of weeding out the important developments of the year, and presenting the facts with precision and conciseness.

Apparently the previous volume was criticized in some quarters for repetitions in different chapters. While this reviewer did not consider these serious, it is gratifying to note an effort by the editors to correct this defect. At the same time we agree with them that a certain amount of repetition is necessary if the reader is to benefit from the points of view of the various contributing specialists.

New chapters are those on endicrinology, ophthalmology, gynecology, rehabilitation, medical psychology, and physical medicine. Chapters on hypertension, obstetrics, and thoracic diseases were omitted this year.

The review of the surgical field has come under the editorial scrutiny of Charles Mayo and Lowell Smith. Introductory comments on limitations to radical operation are followed by a review of supportive therapy, with emphasis on the complications due to cortisone. Then comes a systematic regional survey and a useful bibliography of 135 items from the literature. Important surgical material is also found, of course, in the chapters on Orthopedic Surgery (Frank Ober) and Gynecology (Ralph Reis). Unfortunately, there seems to be inadequate treatment of the important work in neurosurgery and neurology, and this should be corrected in forthcoming editions.

PHILIP THOREK, M.D.

Surgical Infections. By Edwin J. Pulaski. Springfield, Ill.: Charles C Thomas, Publisher, 1954. Pp. 315, with 10 illustrations.

This is Publication 170 in the American Lecture Series. The book was originated as a small manual on the use of antibiotics in the treatment of surgical infections. One must realize, however, that there is a tendency to rely on these drugs rather than use the sound surgical principles taught in presulfa days. This book is dedicated to the use of antibiotics *properly*, in combination with worthwhile indicated surgical measures.

The monograph is divided into two parts. Part 1 deals with antibiotic therapy, including history, dosage, complications, combinations, failures and the special groups. Part 2 deals with the management of surgical infections. General principles are stated at the outset. Specific infections are detailed, and specific wound infections are discussed thoroughly. The larger portion of Part 2 is devoted to regional infections, from neck, trunk, extremities, and hands, to the physiologically integrated systems involved—i.e., the central nervous system, the lungs, pulmonary, peritoneal, gastro intestinal, etc.

Every doctor, regardless of his field, should be fascinated by such a well organized, readable and readily absorbable text.

JEROME J. MOSES, M.D.

An Atlas of Congenital Anomalies of the Heart and Great Vessels. By Jesse E. Edwards, Thomas J. Dry, Robert L. Parker, Howard B. Burchell, Earl H. Wood and Arthur H. Bulbulian. Springfield, Ill.: Charles C Thomas, Publisher, 1954. Pp. 202.

This atlas is an enlarged second edition of "Congenital Anomalies of the Heart and Great Vessels" (Dry and others: Springfield, Ill., Charles C Thomas, Publisher, 1948).

Many new features have been added in the present atlas. This atlas, which contains magnificent photographs, presents in a condensed form the main gross anatomic and cardiac physiologic aspects of congenital anomalies of the heart and vessels.

A number of photomicrographs demonstrate secondary changes in small vessels of the pulmonary circulation.

The atlas does not pretend to be a textbook on congenital malformations, but it is an excellent summary, with a happy combination of clinical and pathologic data. It will be of great value to the experienced pathologist in evaluating congenital malformations, as well as to the cardiologist, who is interested in congenital lesions of the heart and vessels.

An extensive bibliography, although not complete, gives the most important references for further study of the subject. The young resident in pathology or cardiology will do well to study first the more extensive textbooks and use this atlas after he has mastered the sometimes rather difficult theories of congenital malformations. The book belongs in the library of every pathologist, cardiologist and pediatrician.

WERNER F. EISENSTAEDT, M.D.

Abstracts from Current Literature

Chylothorax and Its Treatment. Le chylothorax et son traitement). Picard-Leroy, G., Presse Méd. 62:61, 1954.

Traumatic chylothorax is very rare, but the increasing frequency of intrathoracic operations has made chylothorax a not uncommon complication.

The most frequent cause of postoperative chylothorax is section of pleural adhesions and the endoscopic division of bands following artificial pneumothorax. It may also complicate pneumonectomy, thoracic sympathectomy, splanchnicectomy, phrenicectomy, stellectomy, esophagectomy, etc. On the other hand, posttraumatic chylothorax is rare because of the depth and protection of the thoracic duct. Spontaneous chylothorax has been observed in cases of mediastinal tumors, tuberculous fibrosis and aneurysm of the ductus. In children there may also be a strange "hygroma" of the duct without apparent cause.

Treatment must first aim at restoring the electrolyte balance and nutrient intake. Some authors reintroduce the chyle, aspirated from the pleural cavity, by intravenous injections. Such aspirations may be helpful, but most often surgical treatment is necessary. The duct is ligated after direct thoracotomy. (The different approaches are discussed.) For bilateral chylothorax with ascites the right-sided route at the level of the eighth rib is preferable. Reimplantation of the duct into a vein has also been tried successfully.

S. A. GUENKDJIAN, M.D.

Selective Surgery for Peptic Ulcer. Johnson, H., and Daintree, O. I. M., Surg., Gynec. & Obst. 98:425, 1954.

The authors, in attempting to find a better operation for gastric and duodenal ulcers, interviewed 823 patients on whom gastric operations or vagotomy had been done twelve months or more previously. Ninety-six per cent of the patients were traced, and most had been interviewed at regular intervals.

They also interviewed 108 patients who had undergone vagotomy alone five to eight years earlier. Just under 60 per cent received lasting benefit and have led normal lives, free from restraint, ever since, though only 33 per cent are altogether symptom free. However, 25 per cent have had to be advised to undergo further surgical treatment, and the remaining 15 per cent, though a little improved and not requiring a second operation, still need medical care.

The authors were not satisfied that they should continue to advise patients to undergo an operation, however safe, which could afford them no better chance of permanent relief than 60 per cent.

It was apparent from their studies of vagotomy that: hypersecretion of hydrochloric acid is checked; the course of the ulcer disease is profoundly modified; clinical failures are caused by scarring, duodenal obstruction and gastric retention; gastric ulcers have occasionally followed vagal resection, recurrent duodenal ulcers are uncommon; the unpleasant side effects of vagotomy, such as diarrhea and malodorous belching, tend to clear up in the course of weeks or months; all symptoms regarded as side effects of vagotomy are much less frequent after combined operations.

Both these authors and others have observed the successful use of vagotomy for gastrojejunal ulcers after earlier inadequate gastrectomy. In their opinion, therefore, it might prevent them if added to such limited gastrectomies in the first place, and they advocate the combination of vagotomy and two-thirds gastrecomy. They hope to achieve effective prevention of recurrent ulcer, such as is gained by radical five-sixths to seven-eighths resection alone, and at the same time win symptomatic results such as go with limited gastrectomy.

Vagotomy plus two-thirds resection in all cases of duodenal ulcer is advocated whenever the bulked twelve-hour gastric night secretion aspirated by continuous suction contains more than 20 milliequivalents of hydrochloric acid. The authors also accept more than 45 units of free hydrochloric acid or more than 65 units of total acid in the bulked juice as evidence of hypersecretion.

Vagotomy with gastroenterostomy is reserved for patients with duodenal ulcer in whom, on account of obesity, emphysema or old age, gastrectomy might be unduly dangerous.

Vagotomy alone has continued to be useful for patients with anastomotic ulcers after earlier gastrectomy, for the operative mortality rate of a second gastric resection is high and the further recurrence of ulcer after it is discouragingly frequent. Vagotomy was occasionally used, too, for recurrent ulcers which had followed gastroenterostomy when the ulcer was small, there had been no hemorrhage, the stoma was unobstructed and well placed, and there was not adhesion to the colon, if the patient was elderly or a bad surgical risk.

The vagotomy is done before the gastric resection. The authors regard the Billroth I method of anastomosis after gastric resection, with reestablishment of gastroduodenal continuity, as the operation of choice for patients with gastric ulcers. They do not attempt to use the Billroth I gastrectomy when the duodenal wall is the site of ulceration or scarring.

In the majority of cases of duodenal ulcer, the authors have performed a Polya gastrectomy, resecting about two-thirds of the stomach. The afferent loop of jejunum is taken to the lesser curvature and a Hoffmeister spur is made, leaving a small stoma, no wider than a dilated jejunum, at the end of the greater curvature. One of their associates has tried a number of left to right anastomoses with the spur still at the side of the lesser curvature in the hope of further hindering the too often precipitate emptying of the gastric stump. They prefer to carry the jejunal loop in front of the colon, where it lies comfortably across the splenic flexure, and they make the afferent loop long enough to prevent sagging or dragging.

The mortality rate for over 823 consecutive cases during the past six years is 1.5 per cent. Of 670 patients for whom the authors' policy for selection was used, 18 per cent complained of colic, 14 per cent of vomiting or regurgitation of bile, and 18 per cent of dumping or hypoglycemic syndromes. All the patients were asked, taking everything into consideration, "Do you think that since your operation you are (1) normal and apparently cured, (2) a lot better, but not normal, (3) only a little better, or (4) no better at all? In the group of patients in whose cases the authors' policy for choice of operations was followed, 60 per cent placed themselves in Category 1, 34 per cent in Category 2, 4.5 per cent in Category 3, 1.5 per cent in Category 4. On the other hand, patients on which a radical gastrectomy had been done were distributed as follows: Category 1, 4.2 per cent; Category 2, 47 per cent; Category 3, 2.9 per cent, and Category 4, 2.3 per cent. The authors conclude that their choice of operation gives somewhat better results than that of radical gastrectomy alone.

HENRY J. ROSEVEAR, M.D.

Preservation of Corneal Grafts by Freezing. Eastcott, H. H.; Cross, A. G.; Leigh, A. G., and North, D. P., Lancet 1:237, 1954.

Difficulty often arises in obtaining suitable corneal material for homografting in man at the precise moment it is needed. In a series of 12 cases the authors have proved that corneal grafts can be taken from cadavers and stored, by freezing, indefinitely.

The grafts were placed in sterile bijou bottles and covered with an excess of 15 per cent Glycerol in Ringer Saline (PH6). After thus standing for one hour at room temperature, the Glycerol-Saline was decanted, leaving just enough to cover the graft. The screw-cap was tightened and the bottles immersed in a container of carbon dioxide and alcohol freezing mixture at 79 degrees C. They are subsequently stored at this temperature after being transferred to a dry container. Both containers were kept surrounded with solid carbon dioxide, held in a lagged "perspex" box in a standard deep freeze.

Thawing was rapid in all cases, the bottle being immersed in a water bath at 40 C. and removed as soon as the graft was seen to be thawed.

Partial thickness grafts gave results that equaled those obtainable with fresh material. Full thickness grafts were less satisfactory, and all showed some opacification.

CLAUDE M. WARREN JR., M.D.

Gallbladder Disease in Adolescents and Young People. Griffin, G. D. F., and Smith, L. A., J.A.M.A. 154:731, 1954.

This study of residents of Rochester, Minn. (population 30,000) was undertaken in order to document the suspicion that the commonly encountered types of gallbladder disease may occur at any age and in significant numbers of persons.

It is true that a majority of patients who have disease of the gallbladder are over the age of 40. Nearly a third of the patients whose cases were collected however, were below this so-called typical age, and there were as many patients between the ages of 26 and 30 as between 41 and 45.

The diagnostic importance of a familial background of gallbladder disease is emphasized particularly when the examiner can rid himself, as the authors advise, of obsolete aphorisms suggesting that youthfulness is incompatible with cholecystitis.

Although it is recognized that cholecystic disease is a complication in more than 50 per cent of patients with congenital hemolytic disease, it does not follow that a majority of adolescents and young adults who have cholecystitis also have congenital hemolytic icterus.

The authors' statistical study indicated that neither congenital hemolytic icterus nor pregnancy can be regarded as a prime cause of cholecystitis in adolescents or young adults.

THOMAS WILENSKY, M.D.

A Clinical Report on the Cytologic Diagnosis of Gastric Cancer. Grimes, O. F.; Traut, H. F.; Wood, D. A., and Farber, S. M., Sur., Gynec. and Obst. 98:347, 1954.

In the crucial early stages of gastric cancer, when the results of roentgenologic study were negative or equivocal, cytologic procedures have permitted positive diagnosis after all other methods had failed. Investigators at University of California Hospital have developed a gastric lavage technic in which papain is used to penetrate the "mucous barrier" in which the desquamated cellular material is largely concentrated.

Experience with this method has indicated that very small gastric cancers, like pulmonary cancers, may exhibit exfoliated diagnostic cells in great numbers.

The authors suggest that, because of the well-recognized tendency of papillomas and gastric ulcers to malignant degeneration, it would seem wise to make periodic cytologic studies of all patients known to have either disease.

Cytologic diagnosis may be the only method of recognizing some gastric cancers while they are in a stage in which surgical treatment may effect long-term cures.

In the authors' opinion, cytologic studies must not be omitted when gastric complaints are encountered in patients who are over 50 years of age and in whose cases it is not possible to arrive at a diagnosis by the usual methods.

THOMAS WILENSKY, M.D.

Chirurgie intracardiac à coeur exsangue sous hibernation artificielle (Intra-Cardiac Surgery on Exsanguinated Heart Under Artificial Hibernation). Laborit, H.; Jaulmes, C., and Kunlin, J., Bordeaux Chir. 4:177, 1953.

Laborit was the first to introduce artificial hibernation. Without any "refrigerating" agents and by the sole use of drugs causing diminished hemogenesis and increased thermolysis the authors have been able to keep dogs at a temperature of 28C. Their pharmacodynamic "cocktail" is alone responsible for this hypothermia; it diminishes the *cellular* vital processes (histoplegia). Thus these experiments differ from those of Bigelow, Crawford and others.

Ganglioplegic preparations have been used for neuro-endocrine blockage, but the authors look forward to a new era of "neuroplegic" drugs with multifocal vegetative, ganglionic, central and peripheral activity, opening new possibilities of "histoplegia"—cell rest and even inhibition of cellular exchanges. On this basis the authors have attacked the problem of cardiac operations with the patient in artificial hibernation.

That which kills the homeothermic mammalian is the disorderly organic reaction to aggression. The drugs used block the endocrine, neurovegetative and homeostatic systems and in the meantime diminish cellular activity. It is a form of general hypobiosis, most marked in cerebral tissue. During artificial hibernation there is no need for carbohydrates and the proteins can look after the diminished needs. The authors have noted that more cellular proteins can be furnished by mobilizing the energy inherent in fat when the pituitary somatotropic hormone is administered.

This has opened new possibilities in cardiac surgery. Exsanguination throws the heart into fibrillation, often irreversible. By the use of pituitary somatotrophin and pharmacodynamic hibernants the authors were able to overcome fibrillation. During this cardiac "arrest" the heart lives in anerobiosis. A cardiac operation is then possible —and safe—in a bloodless field, and the Laborit technic has already been used by many surgeons.

S. A. GUEUKDJIAN, M.D.